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THE DETERMINATION OF THE SOLUBILITY OF DYES*

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A method of determining the solubility of dyes is described. In the conventional methods solubility is assessed by visual examination of the filters used for filtering a series of solutions of increasing concentration. The present method consists in the colorimetric measurement of the filter residues of such a series upon redissolving in water. The filter material is a Dynel fabric, the specifications of which are noted. It possesses no affinity for dyes. The solubility values are determined from graphical data; they are reproducible and are a dependable guide to solubility in practical application.

IN all textile operations where concentrated dye solutions are used, the solubility of the dyes plays an important part. It is especially critical in processes involving short liquor ratios, above all in padding. In the application of water-soluble dyes on the pad, the depth of shade that can be obtained depends, next to the fixation properties, on the solubility. As a result of the increasingly wide adoption of continuous dyeing methods, solubility has come to assume great importance for the characterization of dyes.

The solubility of a substance is understood to refer to the number of grams which are contained in a given volume of a saturated solution; in other words, the saturated concentration at which an equilibrium is reached between the solute and the settled matter which cannot be brought into solution. The position of this equilibrium is temperature-dependent and can be depicted by solubility curves.

Where chemically pure substances are involved, the solubility can be exactly determined by suitable methods and is a constant value of that substance at a given temperature in a given solvent. Commercial dyes, however, are not chemically pure, but are technical products containing varying amounts of inorganic and organic impurities, some of which are poorly soluble. In the course of manufacture, the newly synthesized dye is converted into a filterable form by precipitation with salt, so that it also contains electrolytes. Added to this, a certain amount of common or Glauber's salt is used to standardize the concentrated product at commercial strength.

As a rule the electrolyte content reduces the solubility. With a few exceptions the concentrated dyes therefore have higher solubility than the commercial types which are standardized at a definite strength. Electrolytes are also responsible for the formation of aggregates, a phenomenon which makes it extremely difficult to detect the transition from the molecularly dispersed to the coarsely dispersed colloidal state. If the dye liquor contains incompletely dissolved dye, the dyeings will be faulty, showing poor rubbing fastness and dye specking, while, in package dyeing, filtering out is likely to occur.

On the other hand, it is known that, with certain dyes, the solubility as determined by one of the standard methods can be exceeded without adverse effect on the quality of the dyed goods. In effect, therefore, two values can be assigned to such dyes: the actual solubility and the maximum concentration that is permissible in dyeing. The disparity between these values is connected with the fact that, in solutions of apparently higher concentration than that of saturation, a proportion of the dye is colloidally dispersed. The solubility values derived from conventional filtration methods also depend to some extent on the pore size of the filter medium.

From what has been said, it will be accepted that there are certain limits to the accuracy of the solubility values for commercial dyes as commonly determined.

Zimmermann and McCleary (*1*) describe a method of determining solubility in which the dye solution is sucked with vacuum through a heated Buchner funnel fitted with a filter paper of fine pore size. The solubility is assessed by measuring the optical density of the filtrate with a spectrophotometer. We may mention in passing another method, formulated by the Swiss Association of Leather Industry Chemists, which is based on drop reactions on a specified filter paper.

For rapid determinations, the common practice is to filter a series of solutions of increasing concentration through a standard filter paper or a rayon or cotton filter cloth, the solubility being determined by visual examination of the dried filters. Methods of this kind are described in the literature issued by dye manufacturers.

In our opinion, the dependability of these methods is often open to doubt, because the filter residue cannot always be assumed to consist entirely of water-insoluble impurities and undissolved dye. Another possible source of error is the fact that dyes which have a tendency to bronze may simulate a residue before the true solubility limit is reached.

The new method I am going to describe has been developed in the Sandoz laboratories and verified with over 100 direct dyes. It is based upon colorimetric measurement of the filter residues and gives reproducible values which are a dependable guide to solubility in practical work. In contrast to the previously mentioned method of visual examination, only the water-soluble constituents of the residue are comprehended in the assessment; in this way the element of uncertainty which arises from the presence of insoluble impurities is eliminated.

In formulating the method, we began with the assumption that, when a given volume of a dye solution is filtered under constant controlled conditions, the volume of liquid absorbed or retained by the filter remains constant. When a series of graded concentration is filtered under constant conditions, the amount of dye left on the filter will therefore be proportional to the initial concentration within the region of solu-

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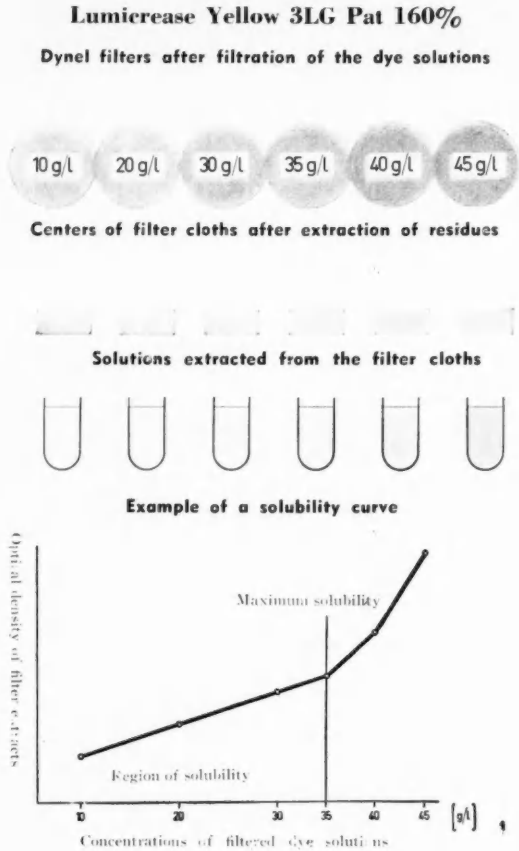

bility of the dye. It follows that, when the filter residues of such a series are extracted in water and the optical density of the resultant solutions is measured, the plotted values will describe a linear curve. The rate of increase in the optical density, expressed as a function of the initial concentration, will show a sharp rise on reaching the limit of solubility due to the accumulation of undissolved dye on the filter. The breaking point will thus provide a value for the maximum solubility.

The next step was to find a filter material which as far as possible would be reserved by dyes, so that the residue could be completely redissolved without harmful effect. Other important considerations were that the pores should be regularly spaced and that the pore size should be such that coarsely dispersed, ie, undissolved dye particles, would be retained. After numerous experiments with paper, various synthetic fiber fabrics and glass, a Dynel filter cloth was found which came close to meeting these requirements. It is a heat-set fabric of plain weave construction and has the following specifications:

Number of warp threads per centimeter: 18.5	Yarn number 20/3 (metric system)
Number of weft threads per centimeter: 13	Yarn number 30/3 (metric system)
Weight: 470 grams per sq meter	

METHOD OF DETERMINING THE SOLUBILITY OF DYES AT 80° TO 85°C——The dye is weighed out in a 500 cc conical flask and 200 cc of distilled water at 80°C is added. Dyes which have poor wettability or show a tendency to lumping are pasted with water before the solution is made up.

The flask is placed on a boiling water bath and heated for 20 minutes with frequent vigorous shaking. In a short time the temperature of the solution increases to 85°C.

The Dynel filter is supported in a Buchner funnel of seven-cm diameter, which is heated or has been previously heated with boiling water. Before filtering, the filter cloth is wet out with 50 cc of boiling distilled water.

The dye solution is filtered at 85°C with weak suction. It is important to see that the partial vacuum remains the same for the entire test series, so that the conditions of filtering are as nearly as possible constant. The vacuum should be adjusted so that the time of flow of the 200-cc samples is 15-20 seconds within the region of solubility.

After filtering, the filter cloth is evenly hydroextracted by strong suction and dried in a drying cabinet at 60°C. A rectangle 45 x 20 mm is punched out of the center of the dry cloth and freed from dye by boiling for a short time in 50 cc of distilled water.

A series of solutions of increasing concentration is filtered in this way, eg, 10, 15, 20, 25, 30 and 35 g/l. The solutions obtained by boiling the filter centers are measured for optical density with a colorimeter. A standard solution is also measured for purposes of comparison. Solutions of very high optical density which lie outside the range of applicability of Lambert-Beer's law must be suitably diluted.

The values for the optical density serve as ordinates and are plotted against the corresponding dye solutions to give an abscissa. The curve is linear in the solubility region but rises sharply on reaching the limit. The concentration of the solution which is coincident with the breaking point is taken as indicating the maximum solubility of the dye. For our measurements we used a visual colorimeter of the Duboscq type.

REFERENCE

(1) Zimmermann, C. L. & McCleary, H. R. *Am Dyestuff Reptr* **37**, P47 (1948).

General Calendar

AMERICAN OIL CHEMISTS SOCIETY
Oct 20-22 (Sherman Hotel, Chicago); April 20-22, 1959 (Roosevelt Hotel, New Orleans, La; Sept 28-30, 1959 (Statler Hotel, Los Angeles, Calif)

AMERICAN SOCIETY FOR TESTING MATERIALS (COMMITTEE D-13)
Oct 14-17 (Sheraton McAlpin Hotel, New York, N Y)

DIVISION OF CLOTHING AND TEXTILES IN EXTENSION, TEACHING AND RESEARCH, UNIVERSITY OF GEORGIA
Nov 7-8 (2nd Textile Seminar, Georgia Center for Continuing Education, Athens, Ga)

THE FIBER SOCIETY
April 29-30 (Fontana Village, NC)

INTERNATIONAL TEXTILE MACHINERY EXHIBITION
Oct 15-25 (Belle Vue, Manchester, England)

SOUTHERN TEXTILE EXPOSITION
Oct 6-10 (Greenville, SC)

SYNTHETIC ORGANIC CHEMICAL MANUFACTURERS ASSOCIATION OF THE UNITED STATES
Luncheon meetings at the Hotel Roosevelt, New York, NY: Oct 8, Nov 12

RESEARCH ON DYEING OF CYANOETHYLATED FIBERS*

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The author discusses several aspects of this interesting new development in the field of textile technology while furnishing a contribution to the knowledge of the dyer and finisher in processing data.

INTRODUCTION

IN addition to the extensive development of wholly synthetic fibers, a new branch of textile research has been originated in America. Attempts have been made to chemically modify raw cotton for the purpose of imparting new properties to it, such as increased resistance to heat, and making it insect- and mildewproof. Various methods have been used to accomplish this. Some of these are: amination (aminoethyl sulfate), carboxymethylation (chloroacetic acid; caustic soda), decrystallization (ethylamine), bromoalkylation (bromoalkylallyl phosphate) and cyanoethylation (acrylonitrile), to name a few.

It is still too soon to pronounce judgment on the textile and economic value of these modified cotton fibers. Even a comparison of these fibers with each other does not, at the present time, give a true evaluation of their future potential. Their development, be it in their preparation or in their applications and possible uses, is still in its infancy and is, for the most part, still in the pilot-plant stage. On the other hand, the dyers and finishers must approach the problems of their application first since each fiber, depending upon how its constitution has been modified, will exhibit variations in its properties (affinity, wettability, levelness of dyeing, etc). It is not out of line to say that a favorable result from concurrent tests by civilian and military groups could cause a sudden intense concentration on the development of some particular fiber with its corresponding effect on the market. This, in turn, would greatly increase the importance of such a fiber and would pose new problems for the textile industry. The cyanoethylated fibers in particular seem to be destined for more thorough investigation.

According to the bibliography cited at the end of this article, a certain amount of work has been done on this fiber, particularly with regard to its manufacture. In this article, production of the fiber will be considered only briefly. The purpose of the remarks on dyeing is to examine the dyeing behavior of the fiber and confirm or revise the information available up to the present. Because the structure of the fiber (nitrogen content, etc) has not been definitely established and the method of its manufacure has not as yet been completely developed, the work done so far on methods of dyeing cannot be considered final, but it does give a close picture of the data available and does offer valuable information on the problem of dyeing the fiber.

As a point of interest, it may be mentioned that, even before the last war, there were various laboratories in Germany which were greatly interested in the addition products of unsaturated compounds, expecially those of acrylonitrile and the higher molecular hydroxy compounds, such as polyvinyl alcohol or carbohydrates, especially cellulose and its derivatives. The results of this work which had, even then, given evidence of valuable properties for the textile use of treated fibers were covered by various patents (I G Farbenindustrie FP 830,863 & 899,954; BP 489,330; Ger P 922,886).

MANUFACTURE OF CYANOETHYLATED COTTON

The basic reaction in treating cellulose with acrylonitrile, using an alkali as a catalyst, can be written as follows:

$$\text{Cell}{-}\text{OH} + \text{CH}_2{=}\text{CH}{-}\text{C}{\equiv}\text{N} \underset{\longleftarrow}{\xrightarrow{\text{NaOH}}} \text{Cell}{-}\text{O}{-}\text{CH}_2{-}\text{CH}_2{-}\text{C}{\equiv}\text{N}$$

As the equation indicates, the reaction is reversible; ie, under certain conditions, a cyanoethylated cellulose fiber can be decomposed into cellulose and acrylonitrile. The following side reactions also take place:

a) $\text{NC}{-}\text{CH}{=}\text{CH}_2 + \text{H}_2\text{O} \xrightarrow{\text{NaOH}} \text{NC}{-}\text{CH}_2{-}\text{CH}_2{-}\text{O}{-}\text{CH}_2{-}\text{CH}_2{-}\text{CN}$

b) $\text{Cell O}{-}\text{CH}_2{-}\text{CH}_2{-}\text{CN} + \text{H}_2\text{O} \xrightarrow{\text{NaOH}} \text{Cell O}{-}\text{CH}_2{-}\text{CH}_2{-}\overset{\overset{\text{O}}{\downarrow}}{\text{C}}{-}\text{NH}_2 + 2\text{H}_2\text{O}$

$\text{Cell O}{-}\text{CH}_2{-}\text{CH}_2{-}\text{CN} + 2\text{H}_2\text{O} \xrightarrow{\text{NaOH}} \text{Cell O}{-}\text{CH}_2{-}\text{CH}_2{-}\text{C}{-}\text{OH} + \text{NH}_3$

c) The hydrolysis of the acrylonitrile to carboxylic acid or amide, corresponding to reaction (b).

Comprehensive researches were carried out by various agencies of the American Government, academic institutions, and in various industrial plants (especially Monsanto Chemical Co, Institute of Textile Technology, American Cyanamid Co, U S Dept of Agriculture) to determine the optimum values of various important factors. The factors considered were: alkali concentration; ratio of water, cotton and acrylonitrile; time; temperature as well as absorptivity of the cotton. These factors were studied to determine their effect on the basic reaction. In this paper we will consider only those results which have the greatest practical importance.

A) PRETREATMENT WITH CAUSTIC SODA, CENTRIFUGING, TREATMENT WITH LIQUID ACRYLONITRILE——

Example 1 (Gaston County Dyeing Company apparatus). About 450 g of cotton yarn is treated 15 minutes at room temperature in a circulating bath with a 1.5% solution of caustic soda and 0.7% of Tergitol Anionic P-28 [$(C_8H_{17})_2NaPO_4$]. It is then centrifuged to retain 70% moisture and finally treated for one hour at about 60°C with liquid acrylonitrile in a nitrogen atmosphere to prevent contact with air. It is then given a cold rinse, neutralized with acetic acid, rinsed again and dried in a stream of warm air.

Example 2 (Three-roller padder with two passages through liquor; closed jig). About 30 kg desized cloth is slop padded with a two percent solution of caustic soda and 0.1% Tergitol Anionic 4 [$C_4H_9CH(CH_2H_5)$-$C_2H_4CH(SO_4Na)CH_2CH(CH_3)_2$] depending upon the type of cloth, nip of 40-95%. It is allowed to stand 30 minutes and then passed into a closed air-free jig filled with nitrogen and

*The names of products mentioned in this article represent mainly trade names registered in the name of the respective manufacturers.

liquid acrylonitrile (liquor ratio 6:1). The goods are treated in the jig at a maximum speed of eight minutes per end for one hour at 60°C, with circulation of the acrylonitrile. The aftertreatment is the same as in Example 1. This process can also be run continuously.

B) SINGLE-BATH TREATMENT———

Example 3 (Gaston County Dyeing Company apparatus). One kg caustic soda, 0.25 Deceresol OS (sodium alkylnaphthalenesulfonate) and 21 kg water are added to about 260 kg acrylonitrile. The mixture is emulsified by stirring for about 30 minutes at room temperature and the emulsion is fed into a package-dyeing unit. About 33 kg of cotton yarn is treated for 30 minutes at 24°C and then 30 minutes at 68° C in the circulating liquor. Finally it is cooled, rinsed, acidified with phosphoric acid and then rerinsed in order to remove any residual acrylonitrile, which is then recovered from the wash water by distillation.

C) CAUSTIC SODA PADDING OF PIECE GOODS———Goods are padded with caustic soda, passed through a Standfast Unit or similar liquid metal bath (affording at the same time a seal for the acrylonitrile vapor chest), passed through a chamber saturated with acrylonitrile vapors, passed a second time through a liquid metal bath (again sealing the vapor chest and "deaerating" the goods of acrylonitrile), and aftertreated.

In this way, all types of cotton goods, skeins, loose stock wound packages, ribbons and piece goods can be cyanoethylated relatively easily.

In addition to the laboratory installation, there is also a pilot plant in Georgia which produced about 8,000 kg of chemically modified yarn and 9,000 kg of chemically modified cloth in 1955. There is also a pilot plant in Texas capable of producing about 10 tons per year. The total loss of acrylonitrile (due to side reactions, operating loss) can be kept to less than the actual amount reacting with the fiber. Three kg of cyanoethylated fiber (nitrogen content 4%) requires one kg acrylonitrile. Usually one works with a fiber that contains three to four percent nitrogen, which, from the practical point of view, is easy to produce, and which, at this nitrogen content, has the best properties.

PROPERTIES OF CYANOETHYLATED FIBERS

Articles by American authors concerned with the development of chemically modified fibers repeatedly state that, other than acetylation, cyanoethylation is the only process which does not alter the basic properties of the cotton or its fibrous structure, and confers on it valuable properties. The most important improvements are resistance to bacteria which rot the fiber and resistance to other micro-organisms, increased stability to heat under dry as well as moist conditions, and greater resistance to abrasion. The tear resistance and tensile strength, which are about the same as that for cotton, remain the same after burial in the earth for 14 days, whereas after the same period of burial ordinary cotton has no tear strength at all. Indeed this property improves as the nitrogen content is increased by additional cyanoethylation.

Further comparisons made by American authors between treated and untreated cotton will be summarized briefly here. Chlorite and peroxide bleaches gave similar whitening effects. There were no important differences in waterproofing and crease-resistance finishes (melamine- and urea-formaldehyde resins). Only the feel of the finished cyanoethylated cotton became fuller and firmer. The water absorption (swelling value) was somewhat higher for the untreated fiber with a low nitrogen content. From this it may be deduced that the untreated fiber has a greater affinity for dyes. The dyeing properties will be discussed more fully further on.

There are two principal disadvantages to the cyanoethylated fibers which, along with the advantages stated above must be considered:

a) higher cost
b) the tendency for the CN group to hydrolize in the presence of alkalis.

Conversely, the sensitivity of the cotton to acids is decreased by cyanoethylation. The reason for this is the modification of the glucose chains in the amorphous zones of the cotton, which are more susceptible to hydrolysis and which are protected against hydrolysis by the chemical substitution. In the case of acid, the attack is upon the glucose chain itself; whereas the alkalis first attack the substituted CN groups, which explains the difference in sensitivity of the two fibers.

DYEING PROPERTIES

As already mentioned, our experiments were designed merely to give a resume of the dyeing properties of cyanoethylated fibers. A thorough investigation of all types of these fibers will be feasible only after the future commercial value of these fibers has been determined. Meanwhile, we carried out individual tests with the various types of dyes. As before, this question still has to be answered: Does any of the cyanoethylated fiber still remain after the fiber has been subjected to the rigors of the dyeing process?

We have already discussed the susceptibility of the fiber to hydrolysis. Either of the following may take place:

a) the CN groups are hydrolyzed to amides or carboxylic acids
b) a reversal of the reaction during manufacture may result in a splitting off of the ether radical Cell-O-CH_2-CH_2-CN with regeneration of the cellulose.

In both cases, the difference in the absorption of dye between the cyanoethylated fiber and cotton does not show up clearly apart from differences in affinity already present in the cotton used as a raw material. In the first instance (a), the definitely more active carboxyethylated cotton is obtained; in the second case (b), the structure of the amorphous zone and, to some extent, that of the crystalline zone of the cotton becomes less compact so that the regenerated cotton has a greater affinity for the dye than it had before cyanoethylation. Therefore, a nitrogen determination must be run on the fiber to determine what has taken place, since, in both of the above cases, there will be a change in the nitrogen content of the fiber.

In making comparisons with cotton, we treated samples of cyanoethylated cotton with (I) a four percent nitrogen content, and (II) with a 3.5% nitrogen content, in the following manner:

a) control: untreated
b) with two cc/l acetic acid 30%, for one hr @ 90°C
c) with 20 g/l Glauber's salt for one hr @ 95°C
d) with 50 cc/l caustic soda 38°Be for one hr @ 90°C
e) same as (d) plus 25 g/l hydrosulfite conc for one hour @ 90°C
f) same as (d) @ 60°C
g) same as (e) @ 60°C.

With respect to the nitrogen content, the following results were obtained. In the neutral (c) or the weakly acid medium (b) the fiber is stable at the higher temperatures (90 and 95°C). A certain sensitivity to

acid occurs at lower pH, although, according to American experiments, it is only partial. Therefore, the fiber may for the most part retain its original composition when acid, basic, direct, naphthol or water-soluble leuco esters of vat dyes are used. The picture changes in an alkaline medium. Relatively high concentrations of caustic soda will, with increasing temperatures, cause a splitting off of nitrogen with the evolution of ammonia. At 60°C (f), the fiber is not appreciably attacked, but after one hr at 90°C virtually all of the nitrogen is split off. The presence of a reducing agent (e, g) intensifies the release of nitrogen to some degree.

Thus it can be stated that vat dyes and sulfur colors can be applied to the fiber at temperatures up to 60°C. Higher temperatures and increasing alkalinity (continuous dyeing, blacks, deep shades and especially high-temperature level dyeings) due to longer dyeing time attack the fiber, and any improved affinity thus attained is not a result of cyanoethylation but of a loosening of the structure of the cotton (as occurs, for instance, in mercerization). Although carboxyethylated cotton is also formed in the process, the changes which the cotton undergoes are uncontrollable, and can cause many practical difficulties (streaks in the warp, etc). Similar considerations also apply to other alkaline treatments, eg, bucking, laundering, caustic treatments, etc.

From the Indanthren vat dyestuffs, a few characteristic examples were chosen in order to check their reaction with the modified fiber.

FASTNESS TO LIGHT AND TO WASHING — Vat Yellow 1, *CI* 70600, appeared to us to be particularly suitable because of its moderate fastness and also because it is strongly phototropic. Strangely enough, while the lightfastness on the treated samples (I and II) is only slightly better, the phototropic nature is distinctly decreased. This demonstrates the dependence of phototropism on the fiber being used.

In the case of hand washing with some friction, no remarkable difference was observable. The color change after washing in a boiling soap bath (Vat Red 18, *CI* 60705) showed approximately the same difference; in all three cases (washing "b", hand washing with rubbing, and washing at the boil) the color turned a little yellower. It is interesting to note that the original shade dyed on cotton differs from that dyed on the cyanoethylated fiber. While in the case of the Vat Red 18, cotton showed the well-known bordeaux tone, I and II showed an oxblood tone. This illustrates the dependence of the color tone on the dispersion and the forces of attraction between dyestuff and fiber.

OTHER FASTNESS PROPERTIES ——— As regards fastness to rubbing, there did not seem to be much difference. It is interesting to note the difference in shade of the original dyeings (Vat Black 9, *CI* 65230); the dyeings likewise show similarity in sensitiveness to ironing and water spotting (Vat Blue 20, *CI* 59800). On the other hand, the fastness to chlorine of dyeings of Vat Blue 4 (*CI* 69800/1), dyed at 60°C on cyanoethylated cotton, is 1 to 1½ grades better.

OXIDATION AND REDUCTION ——— Overreduction, which is a characteristic of Vat Blue 4, also appears on dyeings of cyanoethylated cotton with this color, but the original color tone on this fiber is much more brilliant and redder than on cotton; on this account over-reduced dyeings do not come up with such a strong green shade.

For the sake of completeness, a test of the effect of oxidation on Vat Yellow 20, *CI* 68420, was made, in which it was found that I and II acted a little better.

DYEING RESEARCH

VAT COLORS ——— The effect of cyanoethylation on the amorphous and possibly also on the crystalline sites of cotton partially explains the increased affinity for dyestuffs and the more rapid rate of exhaustion of the bath when dyeing with Vat Red 40, *CI* 68300, for example. But the role of the newly introduced CN groups so suitable for the building of hydrogen bridges should not be overlooked in this connection.

On the other hand, dyeings on cyanoethylated material are harder to dye level (Vat Black 25, *CI* 69525), even with addition of leveling agents (0.5 cc/l Albigen A, blank bath, at 85°C for 45 minutes), and more difficult to strip (three cc/l Albigen A, blank bath, at 85°C). There is a distinct difference of tone between the cotton (grey-olive) and the cyanoethylated material (greenish olive).

Higher dyestuff absorption can be noted on the cyanoethylated fiber. The accompanying speedier exhaustion of the bath and lower rate of migration are by no means helpful in practical dyeing. Account must be taken of the difference in shade between the color produced on this fiber as compared with the color on cotton, and allowance made therefore. With some dyestuffs, this difference in shade is very marked.

As regards fastness properties, there are no particular difficulties; what slight differences there are have been found, up to the present, to be of only secondary importance. Unfortunately, we had no piece goods with which to make these experiments. The fact should not be overlooked that the penetration of piece goods (in jig dyeing), as compared with that of cotton, on account of the speedier exhaustion of the dyebath, may not be too good; this point has yet to be proved.

DIRECT COLORS———In the case of dyestuffs of this and the following classes, the dyeings were made according to the instructions prescribed in the color cards. These dyestuffs showed higher color yield and were more brilliant, although some of them exhibited a somewhat different shade on the cyanoethylated material [Sirius Supra Blue BL, Direct Blue 2 (*CI* 22590)].

OTHER COTTON COLORS——— The basic dyestuffs showed a marked fluorescence in the dyeings on this fiber [Basic Violet 10 (*CI* 45170), Direct Green 6 (*CI* 30295)], and better color yield with increasing nitrogen content of the fiber (dyeing without mordant). Likewise the sulfur colors (Sulfur Black 6, *CI* 53295) and the naphthol colors [Azoic Coupling Component 2 (*CI* 37505), Azoic Diazo Component 5 (*CI* 37125)] were distinctly bloomier and deeper in color on the cyanoethylated fiber. Water-soluble leuco esters of vat dyes can also be dyed on this material, but as they do not show any marked difference in dyeing behavior from the vat colors, it is unnecessary to discuss them separately here.

DISPERSE COLORS ——— Although the fundamental structure of cotton is not entirely altered by cyanoethylation, its dyeing properties are considerably broadened, as some dyestuffs which merely stain ordinary cotton produce full shades on the modified fiber. For example, Disperse Red 1, *CI* 11110, and Disperse Orange 3, *CI* 11005, are colors of this type.

WOOL COLORS ——— With the building in of the CN group, cotton becomes "wool like" and, in dyeing with wool dyestuffs, stands in color yield between cotton and wool. With increasing nitrogen content, the depth

of shade increases, as would be expected. Its increased complex-forming properties for cuprous ions (copper method) raises its dyestuff absorption. In this connection may be named the following dyestuffs: Fast Red AV, Acid Blue 151 and Acid Blue 153. Although the dyeings on cyanoethylated fibers are considerably deeper in shade than those on cotton, they still do not reach the high color yield produced on wool, which is understandable from the chemical point of view. In the case of the wool dyestuffs requiring large percentages of acid, there is a danger of hydrolytic splitting of the cyanoethyl group on long boiling, whereby the fiber is converted back to cotton and loses its affinity for the wool dyestuffs.

FUTURE PROSPECTS

Cyanoethylated cotton is perhaps the most interesting modification of cotton by chemical means since the discovery of acetylated cellulose. Its improved characteristics, such as resistance to bacterial and microbial attack, its thermostability and superior abrasion resistance should make it interesting for many end uses, military cloths and as material for tropical clothing, for example. The introduction of the CN group makes the cotton more wool-like, and gives it more affinity for a greater range of dyestuffs. Many dyestuffs so dyed on it exhibit superior fastness (fastness to light, chlorine, etc). The higher color yield produced on this fiber, when dyeing with direct cotton colors, and the somewhat improved brilliance and clarity of these colors are of prime interest to the dyer. Another advantage is that it is possible to obtain better solid shades on mixtures of wool (or synthetic fibers) with cyanoethylated fiber by using specially selected dyestuffs.

In the dyeing of cyanoethylated cotton with many classes of dyestuffs (disperse colors, naphthol colors and direct dyestuffs) unexpected results may be obtained with respect to the fastness properties (fastness to light, washing, rubbing and gas fading). The research bound up with these questions is so very extensive that, in the face of the uncertainty of prospects of success of the cyanoethylated fiber, this work has not been completed.

The difficulties involved should not be overlooked. The higher cost of the fiber, compared with ordinary cotton, would appear to rule out its use on a large scale for anything but specialty applications. The susceptibility of the fiber to alkali under conditions of high temperature and concentration and long treating time may also, as pointed out above, hinder its successful development. The influence of alkali under such conditions causes hydrolysis of the fiber, with "regeneration" of the cotton, and the resultant changes in shade, brilliance and depth of shade are potential causes of unevenness, streakiness, "ending" and other faults in vat dyeing.

Further development of the new fiber, especially from the industrial point of view, must be awaited. The interest taken in America is noteworthy where extensive tests are being carried out by the U S Department of Agriculture and some branches of the Armed Services.

The foregoing remarks should therefore give some hints regarding this interesting new development in the field of textile technology. They should furnish a contribution to the knowledge of this much talked-about fiber for the benefit of the dyer and finisher, who should not neglect such modern developments, as he may need to acquire such data for use in the near future.

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Dyeing Hydrophobic Fibers in Solutions of Solvents

Gokhale, M K, Peters, L, and Stevens, C B, *J Soc Dyers Col* **74**, 236-40, April, 1958.

Following the discovery that aliphatic alcohols assist the dyeing of wool and silk at temperatures lower than is usually considered possible, it was thought interesting to examine their effect on the dyeing of man-made fibers. Hydrophobic fibers, in general, ought to have affinity for the sparingly soluble alcohols used, and dyes for such fibers ought to be readily soluble in such solvents. Cellulose triacetate was selected as a likely prospect.

Data are presented concerning the rate of dyeing of triacetate loose staple fiber with 3% Duranol Red X3B 300 (*C I* Disperse Red 11) from aqueous solutions of *n*-butanol or benzyl alcohol. In water saturated with *n*-butanol, more than 85% exhaustion is reached after one hour at 80°C, 30 minutes at 60°C, or one hour at 40°C. After 30 minutes in water saturated with benzyl alcohol, 68% of the dye present is fixed on the fiber at 40°C, 78% at 60°C, and 80% at 80°C. In general, with either solvent, the highest amount of dye fixation is obtained at about 60°C. At higher temperatures, less solvent is needed and the time of dyeing can be reduced.

The authors report a practical trial made with this process in a jig on Tricel locknit fabric at 60°C for 30 minutes, in a solution saturated with benzyl alcohol. The cloth was uniformly dyed a deep color, and the fastness to washing was classed as 5.

Small samples of Terylene fabric were also dyed to a heavy shade with this dye, using the benzyl alcohol method. Without the alcohol the dye gave only a faint tint.

Some Aspects of Bleaching with Hydrogen Peroxide and with Peracetic Acid

Chesner, L and Woodford, G C, *J Soc Dyers Col* **74**, 531-41, July, 1958.

Hydrogen peroxide as a bleaching agent has the advantages of being an easily handled odorless liquid which is available in a convenient and safe form. In use, it is economical and labor-saving. A main factor which has contributed to its popularity is the extremely high stability of the present-day product.

The bleaching of wool with hydrogen peroxide has been firmly established for a long time, although the techniques have been improved with the passing years. These fall under three principal headings:

1) Alkaline steeping processes
2) Acid processes followed by aging

(*concluded on page 697*)

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October 6, 1958

AATCC Research ——

ABRASION TESTING OF TEXTILES WITH THE ACCELEROTOR

Reproducibility in Interlaboratory Tests*

T F COOKE

Chairman, AATCC Committee on Resistance to Abrasion

This paper is the second of a series planned on the application of the AATCC Accelerotor to abrasion problems in connection with the rapid evaluation of textile and other materials for resistance to dry or wet abrasion and to alternate wear-laundering cycles.

The first paper, "The Accelerotor for Abrasion Testing and Other Purposes", published in the September 10, 1956 issue of *American Dyestuff Reporter* 35, P685, presented a general picture of the diverse applications of the Accelerotor to abrasion testing of textiles, paper, and nonwoven fabrics; as well as for the creation of felting and shrinkage of wool; evaluation of the fastness of dyed textiles to laundering abrasion; durability of finishes; detergents; fraying; pilling; etc. Theoretical considerations and principles involved in the high-speed testing of unfettered specimens in random motion were discussed.

Presented in this present paper are the results of a statistically planned interlaboratory abrasion test program based on the Accelerotor as the testing instrument.

The objective was to establish, on a broader basis than heretofore attempted, the degree of reproducibility of the weight loss of specimens obtainable in the Accelerotor.

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*Cooperating nonmember

Evaluation and rating of wear damage was based on the percentage loss in weight of fabric specimens after rapid tests of a few minutes duration in the Accelerotor.

Seven Accelerotors with individual operators were involved in the test. Three classes of fabrics ranging from cotton work clothing weights through cotton sheetings to light weight rayons were studied. Mercerized, resinated, and both mercerized and resinated finishes were included.

Two types of test, with respect to speed of rotor, were stipulated: 1) constant (*maintained* at a *definite* speed) and 2) uncontrolled (requiring designated starting speed which is allowed to *increase* at the will of the fabric as its stiffness, bulk and weight decrease during the test.) These two types provide interesting relationships to stiffness, bulk, influence of finishes or their breakdown, moisture content, etc.

Time as well as a comparison of grit vs frictional (no-grit) abrasion were also studied.

The results of the test program were most gratifying. Excellent reproducibility was established.

Based on the information obtained, quantitative, rapid test methods are being developed for evaluating fabric deterioration due to abrasion factors.

Operating details of the test procedures are given and statistical data and summaries are tabulated.

The fine cooperation of T F Cooke, his committee and especially the participants, in advancing the development of information about abrasion testing was a very important factor in this work and is gratefully acknowledged.

H W Stiegler
Director of Research

INTRODUCTION

IT is well recognized that abrasion testing has been a serious problem in industry, particularly from the viewpoint of satisfactory reproducibility and realistic end-use prediction.

These disturbing difficulties had been under investigation for some time by a joint committee of ASTM and AATCC researchers. When the potentialities of the Accelerotor® for extremely rapid and realistic abrasion testing became apparent, the AATCC Committee on Resistance to Abrasion was charged with developing information on reproducibility in the instrument in interlaboratory tests.

This paper, therefore, deals with the problem of reproducibility of tests in the AATCC Accelerotor.

The Accelerotor has become firmly accepted for numerous purposes and the Committee on Resistance to Abrasion has been investigating the instrument. Before answering the pressing need for standard test methods, it was the desire of the Committee to establish reproducibility of results in an interlaboratory test involving about seven Accelerotors operated by as many individuals and under identical conditions. If reproducibility was within acceptable limits, plans could be made for development of a series of test procedures for various classes of fabrics and types of end-use.

Work clothes fabrics were considered especially significant as a class for investigation. Fortunately, the Du Pont Company is running field tests on such fabrics and will share with AATCC all of their fabrics and garments as well as data developed on them with respect to end-use. Three twills were evaluated in the Accelerotor some time ago in the AATCC Laboratories (Dacron-cotton; a medium grade cotton and a better grade cotton fabric).

For a lighter type of cotton fabric, samples were chosen from a series of fabrics having a detailed history of quality, construction and physical test data (medium-grade cotton

* Joint contribution of the AATCC Committee on Resistance to Abrasion and the AATCC Research Laboratories.

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sheeting in unfinished, mercerized, resinated, mercerized and resinated states). These were generously shared with AATCC, together with all data, by the Textile Research Institute.

For a lightweight fabric, rayon was chosen (control and resinated).

The fabrics were tested by two kinds of abrasion: 1) grit, 2) frictional. This was accomplished by means of a grit-containing liner and a no-grit rubber liner. The cutting or "nicking" action of the grit tends to produce fibrils on the fibers whereas frictional abrasion does not.

The more fragile rayon fabrics were tested only on a no-grit liner.

The test was organized on a statistical basis in order to obtain as much information as possible from the work with respect to instruments, operators, weight loss of the specimens, speed, durability of the grit liners, etc.

The fabrics were tested by two speed systems: 1) the operator *maintains* a specified speed throughout the test, 2) the test is *started* at a specified speed which is allowed to increase at the will of the fabric specimen as it becomes more limp and lighter in weight.

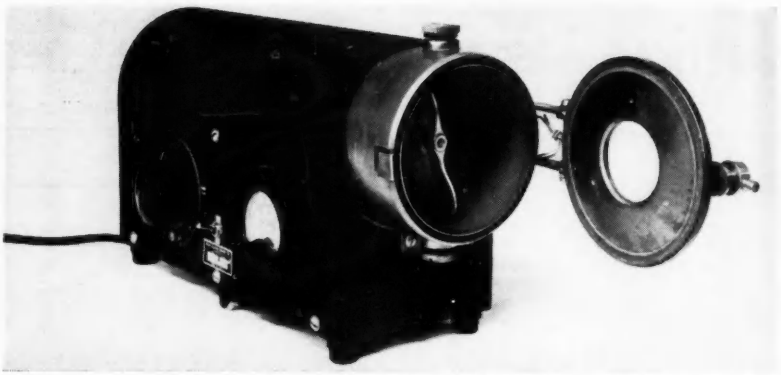
To maintain focus on the objective of the interlaboratory test, namely, *reproducibility* of results in Accelerotor instruments, as many variables as possible were eliminated by having all specimens prepared and weighed (before and after test) at the AATCC Laboratories under standard conditions of 70°F-65% rh.

All instruments were connected to the same line and were checked for speed with a Strobotac intermittent light beam speed tester. In uncontrolled speed tests, all operators started and stopped tests at a given signal and the speed at the start and at the end of the tests was recorded.

Details are recorded in this paper with respect to test procedures, weight loss of every specimen, effect of types of liners, types of fabrics, effect of the order of running various samples on abrasive liners, etc.

Statistical analyses were made with respect to reproducibility and agreement between instruments, precision of test results, ranking of specimens by constant- and uncontrolled-speed methods, different operators on different Accelerotors, etc.

Detritus from the Dacron-cotton twill was collected for analysis to establish any differences in ratio of the two fibers in detritus and fabric. It is planned to publish in a future paper the relationship between fiber ratios and end-use wear results from field tests now in progress.



Accelerotor fitted with abrasive liner over foam-rubber cushion for dry wear testing with 4½-inch pitched blade rotor

STATISTICAL DESIGN

WORK CLOTHING TWILLS——

Let A = Dacron/cotton
B = eight-oz cotton
C = 7.5-oz cotton

Accelerotor Number

1	*2*	*3*	*4*	*5*	*6*	*7*
A	A	B	B	C	C	A
B	C	C	A	A	B	B
C	B	A	C	B	A	C
B	C	C	A	A	B	A
C	B	A	C	B	A	B
A	A	B	B	C	C	C
C	B	A	C	B	A	A
A	A	B	B	C	C	B
B	C	C	A	A	B	C

For purposes of coding, the samples in the above table were numbered according to the Accelerotor that was employed to run the samples and the order in which it was run. For example, the first column was coded 1-1, 1-2, 1-3, 1-4, 1-5, 1-6, 1-7, 1-8, and 1-9, in that order. The first code number refers to the Accelerotor; the second refers to the order in which the sample was run.

COTTON SHEETINGS——

Accelerotor Number

1	*2*	*3*	*4*	*5*	*6*	*7*
1	4	2	3	1	1	1
2	3	1	4	2	2	2
3	2	4	1	3	3	3
4	1	3	2	4	4	4
2	4	1	3	1	1	1
3	1	4	2	2	2	2
4	2	3	1	3	3	3
1	3	2	4	4	4	4

In the above table, the numbers refer to the following samples:

1—Mercerized and resinated
2—Mercerized
3—Resinated
4—Untreated

In this case, the code numbers for the specimens in the first column were 1-10, 1-11, 1-12, 1-13, 1-14, 1-15, 1-16, and 1-17.

RAYON SAMPLES (UNTREATED AND TREATED)——

Let U = Untreated
T = Treated

Accelerotor Number

1	*2*	*3*	*4*	*5*	*6*	*7*
U	T	U	T	U	T	U
T	U	U	T	T	U	U
U	T	T	U	U	T	T
T	U	T	U	T	U	T

The code numbers for the first column were 1-18, 1-19, 1-20, and 1-21.

OPERATING INSTRUCTIONS FOR THE INTERLABORATORY TEST

CONSTANT-SPEED METHOD——

Preparation and Adjustment of Accelerotor.

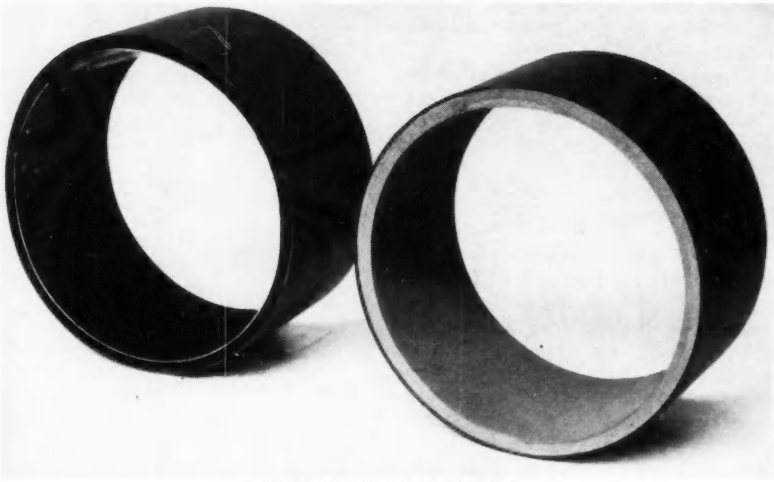
1) Equip Accelerotor with 4½" pitched blade rotor and #250 abrasive liner over ⅛" neoprene sponge rubber which is mounted on the plastic collar.
2) Start Accelerotor and adjust "no-load" speed to 3600 rpm.
3) Check this speed with Strobotac light. If necessary, adjust Tachometer (zero adjustment screw) to indicate true speed.
4) "Break-in" the liner with 80 x 80 cotton. Crumple specimen and place in front of rotor. Close door, start Accelerotor and maintain speed at 3000 rpm for eight minutes.
5) Repeat "break-in" as above.

Work Clothing Twills.

1) Test the twill specimens in the order assigned.
2) Start on signal.
3) Run at 3000 rpm for six minutes.
4) Stop on signal. Save detritus from the Dacron/cotton specimens for later analysis.

Cotton Sheetings.

1) Test the specimens in the order assigned.
2) Start on signal.
3) Run at 3000 rpm for two minutes.
4) Stop on signal.



PLASTIC COLLAR INSERTS
(Left) No. 250 abrasive liner mounted over ⅛" black neoprene sponge rubber in plastic collar. (Right) Non-abrasive liner in form of ¼" gray neoprene sponge rubber in plastic collar.

Rayons — Untreated and Resin-Treated.

1) Remove the abrasive-lined collar from Accelerotor and replace it with ¼" gray neoprene sponge rubber (non-abrasive liner) butted into place in the Accelerotor chamber and secured with plastic tape.
2) Test the specimens in the order assigned.
3) Start on signal.
4) Run at 3000 rpm for three minutes.
5) Stop on signal.

UNCONTROLLED-SPEED METHOD———

Preparation and Adjustment of Accelerotor, "breaking in" a new liner.

1) Install a fresh #250 abrasive liner over the neoprene sponge rubber cushion liner on the plastic collar.
2) "Break-in" the liner with 80 x 80 cotton. Crumple specimen and place in path of rotor. Close door and on signal start test. Adjust quickly to 2700 rpm (at approximate Powerstat setting of 45). Do not change this setting for cotton twills.
3) Run for eight minutes, recording speed at end of test.
4) Stop on signal.
5) Using same Powerstat setting, repeat the "break-in" with a second piece of 80 x 80 cotton.

Work Clothing Twills.

1) Test the twill specimens in the order assigned.
2) Using same Powerstat setting as above, start on signal.
3) Run for eight minutes, recording speed at start and end of test.
4) Stop on signal.

Cotton Sheetings.

1) Test the specimens in the order assigned.
2) Start Accelerotor and adjust quickly to 2900 rpm (at approximate Powerstat setting of 47). Do not change this setting for cotton sheetings and viscose rayons.
3) Run for two minutes, recording speed at end of test.
4) Stop on signal.

Rayons — Untreated and Resin-Treated.

1) Remove collar and replace it with a ¼" gray neoprene sponge rubber liner.
2) Test the specimens in order assigned.
3) Using same Powerstat setting as above, start on signal.
4) Run for three minutes, recording speed at start and end of test.
5) Stop on signal.

STATISTICAL ANALYSES

WORK CLOTHING TWILLS———

1) Ranked in the order of the best abrasive quality first are:

1—	30% cotton/70% Dacron,	6.5 oz (9.7% loss)
2—	100% cotton,	8.0 oz (12.1% loss)
3—	100% cotton,	7.5 oz (13.1% loss)

2) Both speed methods (constant- vs uncontrolled-speed) ranked the fabrics in the same order.

3) There was no difference in results due to the order in which the fabrics were run on a given liner, even though the sequence was varied in order to check any loss of abrasive efficiency of the liner after as many as nine tests.

4) There was no difference between results obtained by the several laboratories, except for laboratory #7, uncontrolled-speed, which gave a positive bias (higher losses but with the same ranking of samples) and laboratory #5, constant-speed, which showed a negative bias.

Laboratory #7, constant-speed, was the only instance where a different ranking was obtained. This is attributed to obvious difficulties with laboratory #7's instrument, which prevailed throughout the test.

5) The uncontrolled-speed method for these twills gave slightly better precision.

COTTON SHEETINGS———

1) Ranked in order of their abrasion resistance by the constant-speed method, with the best one first, are:

1—Untreated	2.0% weight loss
2—Mercerized	2.2% weight loss
3—Resinated	11.2% weight loss
4—Mercerized & Resinated	9.8% weight loss

There is no significant difference between fabrics 1 and 2 at 0.95 level and only a slight difference between fabrics 3 and 4. There is a very large significant difference between resinated and nonresinated samples. The same ranking is obtained by both methods.

2) The constant-speed method is more precise and therefore is able to detect smaller differences between the qualities of two fabrics.

3) There was no significant difference between the results obtained by the seven laboratories except laboratory #5, uncontrolled-speed, and laboratory #7, uncontrolled-speed.

4) There was no significant difference due to the order in which the fabrics were run on a given liner, indicating that the wearing down of abrasive efficiency of the liner was not affecting the results after as many as eight tests on the same liner.

5) Using a single specimen, the constant-speed method can detect differences of 1.74% loss of weight due to abrasion. Using the uncontrolled-speed method and a single specimen, only differences in loss due to abrasion of 3.75% or greater can be detected at the 0.95 confidence level.

RAYONS———

1) Ranked in order of their abrasion resistance by the constant-speed method are:

1—Untreated	1.3% weight loss
2—Resinated	21.2% weight loss

2) There was no question that the untreated rayon fabric displayed better abrasion resistant qualities than the resin-treated fabric. Every laboratory agreed on this point.

3) There was no significant difference in results between laboratories except for #5, #7 in the uncontrolled-speed method of testing.

4) As in the case of the twills and the sheetings, there was no difference in results due to the order in which the fabrics were run on a given liner, indicating that there was no significant loss of abrasive efficiency of the no-grit liner.

5) Better precision is obtained by the constant-speed method. The same ranking was obtained by both methods.

PRECISION OF BOTH METHODS

Using Single Specimen
0.95 Confidence Level-Least Significant Difference

	Constant-speed method	*Uncontrolled-speed method*
Cotton sheetings	1.74	3.75
Twills	2.17	1.21
Rayons	2.34	4.45

CONCLUSIONS

The outcome of the tests and statistical analyses exceeded expectations. Excellent precision and agreement between Accelerotors and operators were demonstrated on all three categories of fabrics. The Accelerotor has excellent potentialities in various types of abrasion studies and testing.

The Accelerotor appears to provide a good reproducible test for mechanical abrasion resistance and is able to detect, with very good precision, small differences in mechanical abrasion resistance between fabric samples.

Running the Accelerotor at a constant speed ranks samples in the same order of abrasion resistance as the uncontrolled-speed method.

There is excellent agreement in abrasion resistance between laboratories running similar samples under the same conditions in different Accelerotors. Only in a few isolated cases were some laboratories higher or lower in results. The same ranking of fabrics was obtained between laboratories when real differences existed between fabrics.

No significant difference in abrasion resistance is obtained when the different fabric types are run in the Accelerotor in a different order, indicating that the wearing down of abrasive efficiency of the liner for the duration of the interlaboratory test was not affecting the results. This is true whether the grit or no-grit liner is used.

In most cases, the running of samples by the constant-speed method is more precise than the running of samples by the uncontrolled-speed method.

FUTURE WORK

Efforts should be made at once to set up a tentative test method for one or more classes of fabrics based on weight-loss classification.

Interest has been expressed in the application of the "edge-wear" test for *visually* evaluating and comparing wear characteristics of fabrics intended for similar end-use purposes. This test is very useful for the study of fabric behavior toward abrasion at edges of cuffs, sleeves, collars, folds and seams and adds considerable information to the quantitative weight-loss data about a fabric. The Committee is therefore considering setting up a test method for this type of wear.

Correlation of test results with a wider range of end-use wear effects is necessary. The gathering of end-use materials and data or cooperation in running actual wear tests should be encouraged.

ACKNOWLEDGMENT

Special commendation is expressed to the following participants in this test: P J Fynn, J C Penney Co; L C Legere, E I duPont de Nemours & Co, Inc; A R Palfy and D H Patt, American Cyanamid Co; N H Sherwood, B F Goodrich Chemical Co; R L Stutz, Better Fabrics Testing Bureau; and C O Werner, American Viscose Corp.

The cooperation of G Switlyk, formerly of American Cynamid Co and now with E I duPont de Nemours & Co, Inc, in statistically setting up the tests and in the statistical analyses and interpretations is gratefully acknowledged.

The cooperation of E I duPont de Nemours & Co, Inc, Textile Research Institute and American Viscose Corp in generously supplying fabrics and data is sincerely appreciated. The Better Fabrics Testing Bureau again offered the facilities of their centrally located laboratories as the test site. This very helpful courtesy is appreciated.

Appreciation is extended for their most helpful cooperation to the AATCC Research Staff and particularly to G J Mandikos, technical manager, and H E Glidden, research associate.

TABLE I
Reproducibility in evaluating work clothing twills

CONSTANT-SPEED METHOD

% Weight loss — six minutes in Accelerotor

Laboratories	*A 30% cotton, 70% Dacron*	*B 100% cotton, 8.0-oz*	*C 100% cotton, 7.5-oz*
1	9.4	13.0	15.0
	8.4	12.0	14.3
	8.5	10.8	13.4
	8.8	11.9	14.2
2	9.1	11.1	13.0
	8.1	10.6	12.0
	8.2	10.5	11.0
	8.5	10.7	12.0
3	9.7	11.5	12.2
	9.0	10.4	11.6
	8.9	10.1	11.0
	9.2	10.7	11.6
4	9.9	15.0	14.5
	8.1	12.4	15.5
	11.1	13.0	13.0
	9.7	13.5	14.3
5	9.4	8.3	12.0
	9.1	8.1	11.4
	10.6	9.0	11.6
	9.7	8.5	11.7
6	10.4	14.5	15.0
	10.4	12.8	14.0
	10.5	13.7	13.9
	10.4	13.6	14.3
	12.8	16.5	14.7
	10.9	13.0	14.3
	11.4	17.0	11.8
	11.7	15.5	13.6
Grand Average	9.7	12.1	13.1

UNCONTROLLED-SPEED METHOD

% Weight loss — eight minutes in Accelerotor

Laboratories	*A 30% cotton, 70% Dacron*	*B 100% cotton, 8.0-oz*	*C 100% cotton, 7.5-oz*
1	7.4	8.6	11.7
	7.3	9.1	10.9
	7.0	8.2	11.0
	7.2	8.6	11.2
2	7.2	9.1	11.2
	7.0	7.9	11.2
	6.9	8.5	13.3
	7.0	8.5	11.9
3	8.0		10.2
	7.2	10.0	11.2
	8.1	10.0	11.2
	7.8	10.0	10.9
4	7.2	9.0	11.5
	7.3	8.5	10.6
	7.0	7.6	11.2
	7.2	8.3	11.3
5	7.5	9.9	11.4
	7.9	9.9	12.4
	7.3	10.1	11.5
	7.6	10.0	11.8
6	8.9	10.1	14.0
	8.9	10.1	13.6
	8.9	10.8	13.9
	8.9	10.3	13.8
7	10.1	14.4	14.2
	11.3	11.2	14.1
	9.9	11.2	13.4
	10.4	12.3	13.9
Grand Average	8.0	9.7	12.0

TABLE II
Reproducibility in evaluating cotton sheetings

Laboratories	% Weight loss — two minutes in Accelerotor: Untreated	Mercerized	Resinated	Mercerized & resinated
CONSTANT-SPEED METHOD				
1	2.6	2.7	11.0	10.1
	2.2	2.8	8.0	10.6
	2.4	2.8	9.5	10.4
2	1.4	2.0	10.8	9.1
	1.5	1.6	11.6	9.8
	1.5	1.8	11.2	9.5
3	2.0	2.0	12.0	9.8
	2.0	2.0	11.8	9.3
	2.0	2.0	11.9	9.6
4	1.8	2.3	12.5	10.7
	2.0	2.6	12.6	10.8
	1.9	2.5	12.6	10.8
5	2.2	2.2	11.0	10.1
	2.2	2.0	10.1	9.0
	2.2	2.1	10.6	9.6
6	2.2	2.3	12.1	10.1
	2.8	2.5	12.2	9.6
	2.5	2.4	12.2	9.9
7	1.5	2.0	10.0	8.9
	1.6	2.0	10.9	8.1
	1.6	2.0	10.5	8.5
Grand Average	2.0	2.2	11.2	9.8
UNCONTROLLED-SPEED METHOD				
1	2.4	2.5	10.0	10.5
	2.2	2.2	10.5	9.5
	2.3	2.4	10.3	10.0
2	1.8	2.2	13.0	13.0
	1.6	1.9	12.9	10.9
	1.7	2.1	13.0	12.0
3	1.8	2.1	10.9	16.5
	1.6	2.2	11.1	10.9
	1.7	2.2	11.0	13.7
4	2.5	7.0	7.1	8.5
	2.1	7.0	11.9	8.8
	2.3	7.0	9.5	8.7
5*	0.5	0.8	16.0	17.9
	0.9	0.6	12.3	16.0
	0.7	0.7	14.2	17.0
6	1.7	2.2	10.6	9.7
	2.1	2.0	11.8	9.0
	1.9	2.1	11.2	9.4
7**	5.2	5.0	20.1	15.8
	5.1	5.1	20.2	19.2
	5.2	5.1	20.2	17.5
Grand Average	2.3	3.1	12.8	12.6

*Uncontrolled-speed test results were out of line probably because of completion of tests at a later date by untrained operators.

**Uncontrolled-speed test results were out of line because of instrument difficulties which were noted during the test.

TABLE III
Reproducibility in evaluating rayons

Laboratories	% Weight loss — three minutes in Accelerotor: Untreated	Resinated
CONSTANT-SPEED METHOD		
1	1.2	20.0
	1.4	23.0
	1.3	21.5
2	1.6	17.1
	1.4	21.1
	1.5	19.1
3	1.0	21.5
	1.2	21.2
	1.1	21.4
4	1.5	18.1
	1.8	18.8
	1.7	18.5
5	1.0	19.9
	1.2	21.8
	1.1	20.9
6	1.2	22.6
	1.1	22.1
	1.2	22.4
7	1.2	25.0
	1.1	24.6
	1.2	24.8
Grand Average	1.3	21.2

Laboratories	% Weight loss — three minutes in Accelerotor: Untreated	Resinated
UNCONTROLLED-SPEED METHOD		
1	1.2	20.0
	1.4	23.0
	1.3	21.5
2	0.6	18.2
	0.5	17.3
	0.6	17.8
3	0.8	21.9
	0.3	20.8
	0.6	21.4
4	1.1	16.8
	1.3	17.6
	1.2	17.2
5*	0.0	9.5
	0.3	11.2
	0.2	10.4
6	1.3	18.0
	1.5	17.5
	1.4	17.8
7**	2.8	48.4
	3.7	47.2
	3.3	47.8
Grand Average	1.2	22.0

*Uncontrolled speed test results were out of line probably because of completion of tests at a later date by untrained operators.

**Uncontrolled speed test results were out of line because of instrument difficulties which were noted during the test.

TABLE IV
Typical example of statistical calculations (Uncontrolled-speed method—Work clothing twills)

$$\text{SS Fabrics} = \frac{(137)^2 + (167.4)^2 + (212)^2}{18} - \text{CF}$$

$$\text{SS Labs} = \frac{(81.2)^2 + (82.3)^2 + (85.9)^2 + (79.9)^2 + (87.9)^2 + (99.2)^2}{9} - \text{CF}$$

$$\text{SS Positions} = \frac{(59.0)^2 + (54.8)^2 + (59.1)^2 + (56.8)^2 + (55.4)^2 + (58.8)^2 + (57.8)^2 + (56.9)^2 + (57.8)^2}{6} - \text{CF}$$

Total = 516.4
SS Total = 5141.42
CF = 4938.31407

ANALYSIS OF VARIANCE	SS		MS	F
Fabrics	158.11704	2	79.05852	217.057
Labs	27.97481	5	5.59496	15.372
Positions	3.18259	8	0.39782	1.093
Residual	13.83149	38	0.36398	—
Total	203.10593	53		

$\sigma = .6033$

Difference of 1.21% is real for single reading

(Reprints of this article may be obtained by writing to

AATCC National Headquarters, P O Box 28, Lowell, Mass.)

AATCC Research Committee Report———

COLORFASTNESS OF TEXTILES TO INDUSTRIAL LAUNDERING

RALPH B SMITH
Chairman, AATCC Committee on Colorfastness to Washing

INTRODUCTION

The colorfastness of a dyed or printed fabric to washing is an important property of a textile and one which has received a great deal of attention during the past 15 years. The work which resulted in the development of the Accelerated Washfastness Tests IIA, IIIA and IVA (AATCC Standard Test Method 61-1957) was started in 1946, and it was not until several years ago that the many details which required investigation were worked out and the test put on a firm basis.

These Accelerated Tests, however, cover only the ordinary range of textiles in consumer use and are not intended nor are they adequate to predict the colorfastness of work clothing fabrics subjected to industrial use and to washing methods employed by industrial laundries.

In industrial use, work clothes are frequently heavily soiled with oil, grease, dirt and other materials, and are generally washed by methods which will give very high detergency particularly with respect to greasy soil. Such washing formulas are characterized by high alkalinities, low soap usage and temperatures of 180°F or over, produced by admitting steam to the wash-wheel during one or more of the sudsing operations. No bleach is used in these formulas but, even so, they provide a severe test for even the best and properly applied vat dyes. Most of the work clothing fabrics are vat-dyed cottons but fabrics for such uses made from other fibers or fiber mixtures are appearing on the market.

In the Spring of 1955 it was brought to the attention of the AATCC Committee on End-Usage Performance Tests that there was a definite need for a test method which would evaluate the colorfastness of work clothing fabrics to industrial laundering. Work was started on the development of such a test method during the Summer of 1955 by the Committee on End-Usage Performance Tests but the whole program was later transferred to the Committee on Colorfastness to Washing.

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INDUSTRIAL LAUNDERING SERIES

Three series of washing tests were carried out under industrial laundering conditions on representative samples.

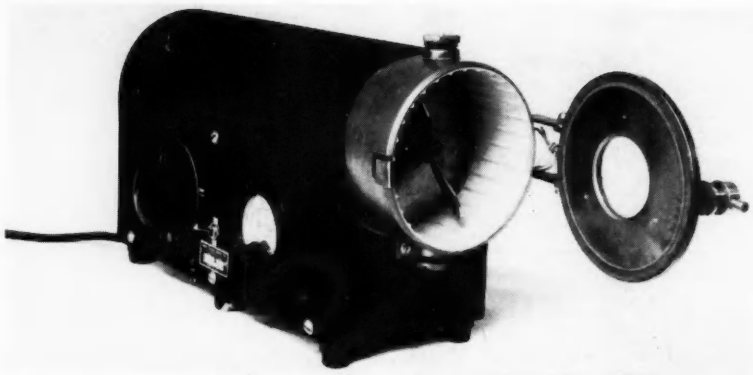
FIRST SERIES —— Eight vat dyed cotton twills were washed one, five, 10 and 20 times by an industrial overalls laundry and by a commercial laundry in their white work formula. These fabrics were seamed about six inches from one edge so as to partially simulate use conditions. Single and multiple IIIA and IVA Tests were run on these samples. Even when these tests were repeated five times on the same samples, the results were not comparable to five industrial launderings.

SECOND SERIES———Eight fabrics similar to those used in the first series of tests plus four cotton twills which had been experimentally vat dyed by methods designed to give maximum dye penetration were washed five, 10 and 20 times by three industrial laundries and in a laboratory by home washing procedures. These fabrics were made up into pant legs prior to washing to simulate use conditions. The washed samples were rated for loss of color, using the International Geometric Gray Scale. The AATCC Accelerated IIIA and IVA Tests were also made on all twelve fabrics.

THIRD SERIES———Two nylon/cotton and three 65/35 Dacron/rayon fabrics along with six of the cotton fabrics used in the second series of laundering tests were washed one and five times in the same laundries participating in the second series. These samples were washed flat since the two prior series of tests had shown that there was no particular advantage to be gained by seaming or making the samples into pant legs. The washed samples were rated for loss of color, using the International Geometric Gray Scale.

DEVELOPMENT OF ACCELERATED TEST

The Accelerated Washfastness Tests IIA, IIIA and IVA were developed to predict the loss of color to be expected when fabrics were processed under conditions and procedures ordinarily used in commercial



Accelerotor fitted for washfastness testing with rubber-ribbed wash liner and offset rotor

and home laundering. This same line of attack was used in the development of a laboratory test procedure which would accurately predict the reaction of a fabric to treatments it would receive in industrial laundering. Thus, the fabrics washed by the industrial laundries were used by the AATCC Research Laboratories as reference standards in the development of an accelerated test which would predict the colorfastness of fabrics subjected to five industrial washings.

The work carried out at the AATCC Research Laboratories showed that:

1) The eight cotton twill fabrics mentioned above gave the same Gray Scale ratings when tested by both the IIIA and IVA Tests.

2) Home washing procedures gave results comparable to the IIIA Test.

3) No practical modification of the IIIA Test would give the amount of color removal produced by five industrial launderings. These modifications included increased alkalinities, temperatures up to 180°F to increase chemical action, the use of a nonionic detergent in place of soap, the use of additional steel balls, the use of steel balls plus a standard sand to increase abrasion, and combinations of these factors.

4) A different approach to the solution of the problem appeared necessary. The application of the AATCC Accelerotor, a small high speed instrument for reproducing effects of abrasion in laundering within a few minutes, was indicated.

5) Tests with the Accelerotor showed that, under suitable conditions, it was possible to duplicate in three minutes the color loss produced by five industrial launderings. A nonionic detergent instead of soap was selected for this test since it gives good wetting without foaming and is easy to rinse out in lukewarm water. Interlaboratory tests on twelve cotton and five mixed fiber fabrics showed that check results could be obtained with the Accelerotor method in different laboratories.

6) The three Dacron/rayon fabrics gave test results with the Accelerotor which indicated bétter colorfastness than was shown by the same samples when subjected to industrial laundering. These fabrics, when tested by the IIIA procedure, showed a staining on an attached white cotton cloth of Step 3 or greater on the Geometric Staining Scale, and when the tested specimens were given a second IIIA test then staining of a fresh white cotton cloth was Step 3. This indicates that such fabrics would continue to bleed with repeated washing.

If these samples are boiled for 30 minutes in a solution containing 0.2% sodium metasilicate and 0.05% nonionic detergent and rinsed, and then tested in the Accelerotor, agreement with five industrial launderings is obtained. For a discussion of the interpretation of these results see the third paragraph under Discussion and Conclusions.

7) The nylon/cotton fabrics showed a staining on white cotton equivalent to Step 4 on the Geometric Staining Scale when subjected to the IIIA Test. When tested in the Accelerotor without the preboil, these fabrics showed a color loss comparable to that obtained in industrial laundering.

DISCUSSION AND CONCLUSIONS

Field and laboratory work has resulted in the test method, "Colorfastness to Industrial Laundering — Accelerated Test, Tentative Test Method 87-1958," which is given at the end of this article. The failure of the Accelerotor test to correlate with industrial laundering as noted in (6) above and the possibility of interference by special fabric finishes has led to the test method presently being limited to cotton fabrics. However, work now in progress should soon make it possible to extend the method to fabrics made from other fibers or mixtures.

The ability of the Accelerotor to duplicate the color removal shown by industrial laundering and the failure of the Accelerated IIIA Test or modifications of this test to produce comparable color removal indicate that the color loss produced by industrial laundering is largely due to abrasion and not to chemical action on the dye. This is true only where the dyes used are relatively stable to temperature and alkali but does not apply where the dyes bleed or are chemically reactive under such conditions.

The Accelerotor, under the conditions of this test, produces dye removal almost entirely due to abrasion, but in industrial laundering the fabric is subjected to abrasion plus chemical and temperature conditions which will cause the bleeding and degradation of certain dyes. The test method, therefore, specifies that it is to be applied only to those fabrics which show "good colorfastness" to the Accelerated IIIA Test. In AATCC nomenclature a rating of 3 is "fair" and a rating of 4 is "good." A sample which rates between Class 3 and Class 4 for staining in the IIIA Test would be borderline and should be tested using a combination of the preboil and the Accelerotor procedure.

The information obtained to date indicates that a combination of the Accelerated IIIA Test (Standard Test Method 61-1957) and this new test (Tentative Test Method 87-1958) will, in almost all cases, predict the colorfastness of a fabric to industrial laundering. However, some fabrics may be treated with special finishing agents, which can interfere with one or both the above tests. Where the presence of such finishing agents is known or suspected, then the sample should be given a preboil before the Accelerotor test.

The information already obtained and the work now in progress should soon make it possible to apply Tentative Test Method 87-1958, with suitable modifications, to fabrics irrespective of fiber content or finish.

ACKNOWLEDGEMENTS

The Committee wishes to thank the Cone Mills Corp, the Textile Fibers Dept of E I duPont de Nemours & Co, Inc, and the Quartermaster Research and Engineering Command for supplying generous yardages of the fabrics used in this work.

Approximately 200 pant legs were sewn especially through the kindness of M Hoffman & Co.

Grateful appreciation is expressed to the Consolidated Laundries Corp, Dixie Overall Industrial Laundry, Institute of Industrial Launderers and Van Dyne-Crotty, Inc, for the industrial laundered samples which served as the basis for the development of the accelerated test. Valuable information was also obtained from the samples subjected to home type laundering at the Good Housekeeping Institute.

Interlaboratory tests were conducted through the courtesy of the following participating laboratories: Better Fabrics Testing Bureau, Technical Laboratory of E I duPont de Nemours & Co, Inc, Monsanto Chemical Co, J C Penney Co, Quartermaster Research and Engineering Command, and Sears, Roebuck and Co.

The Committee also wishes to express its appreciation for the valuable assistance rendered by the research staff at the AATCC National Headquarters not only for the exploratory research, but also for the general coordination of the various phases of this project.

COLORFASTNESS OF TEXTILES TO INDUSTRIAL LAUNDERING

Accelerated Test
Tentative Test Method
87-1958

Purpose and Scope

This accelerated test is especially designed for evaluating the washfastness of work clothing fabrics which are expected to withstand frequent industrial laundering. The color loss resulting from five such launderings is closely approximated by one three-minute test. This test is designed to be applied only to those fabrics which show good colorfastness when tested by Standard Test Method 61-1957, Test No. III A. This test is applicable to cotton fabrics.

Principle

The abrasive action produced by industrial laundering procedures is one of the principle causes of the loss of color shown by fabrics when washed in the above manner. In this test method, the high velocity imparted to the specimen by the Accelerotor produces abrasive effects comparable to those developed in industrial laundering. This test method is to be applied only to those fabrics which pass the III A test (cf STM 61-1957) since the dyes present must also show good fastness when washed at high temperatures and alkalinities.

Apparatus and Materials

Accelerotor *(1)*
Rotor, 4½″ S-shaped *(1)*
Liner, rubber-ribbed *(1)*
International Geometric Gray Scale *(1, 2)*
Stroboscope or neon lamp *(3)*
Automatic timer *(4)*
Adhesive, eg, Vulcanol AL-100-5S *(5)*
Detergent, nonionic, 0.05% solution *(6)*
Acetic acid, 0.014% *(7)*

Test Specimens

Cut three test specimens with pinking shears and adjust weight of each specimen to 3.0 ±0.1 g. according to the following table:

Weight Range of Fabrics	*Approximate Size of Specimen*
8.1 to 9.0 oz/sq yd	4″ square
7.1 to 8.0 oz/sq yd	4¼″ square
6.1 to 7.0 oz/sq yd	4⅞″ square
5.1 to 6.0 oz/sq yd	5¼″ square

Place a specimen on paper and apply a thin ribbon of adhesive (Vulcanol AL-100-5S) from a squeeze bottle to each pinked edge.

Adjustment of Tachometer

Check the accuracy of the tachometer by use of a stroboscope or a neon lamp *(3)*.

Turn the small screw on the tachometer face to correct reading in the desired operating range (2000 rpm). If the neon lamp is used, adjust tachometer to read correctly at 1800 rpm as explained in Note 3.

Procedure

Insert rubber ribbed liner in Accelerotor chamber so that the butt is over the bottom port. (As a precaution, a piece of double-coated adhesive tape is placed between butt and bottom port.)

Crumple test specimen and place in path of rotor (in horizontal position), and close door securely.

Open top port and pour 150 ml of 0.05% detergent solution *(5)* at 80 ±2°F (27 ±1°C) into chamber by depressing rubber liner sufficiently to permit easy flow of liquid. Replace plug in top port.

Set the speed control dial at 50. Start the motor and quickly (ca five secs) adjust to a speed of 2000 rpm. (Average speed, since tachometer pointer usally fluctuates). Run for exactly three minutes (including few seconds used to adjust initial speed) without any further adjustment of speed *(4)*.

Slowly open the door and allow the liquor to spill into a pan or sink. Remove the specimen and squeeze out excess liquor. Rinse each test specimen twice, in beakers, in fresh 100-ml baths of water at 105°F (40°C) for one-minute periods with occasional stirring or hand squeezing. Sour in 100 ml of a 0.014% solution of acetic acid (7) for one minute at 80° F (27°C). Rinse again for one minute in 100 ml of water at 80°F (27°C). Hydroextract or pass the test specimens between wringer rolls to remove excess moisture. Dry by pressing between press cloths with an iron 275-300F (135-150°C).

Evaluation Method for Alteration in Color (Shade and Strength)

The effect on the color of the test specimens can be expressed and defined by reference to the International Geometric Gray Scale (2) (cf page 81 of *1957 AATCC Technical Manual and Year Book.)*

Class 5—negligible or no change as shown in Gray Scale Step 5.
Class 4—a change in color equivalent to Gray Scale Step 4.
Class 3—a change in color equivalent to Gray Scale Step 3.
Class 2—a change in color equivalent to Gray Scale Step 2.
Class 1—a change in color equivalent to Gray Scale Step 1.

It is recommended that the gray scale evaluations be made in a standard-conditions laboratory under a standard color-matching lamp. The washed test specimen should be compared with the original swatch after both pieces have been subjected to the same atmospheric conditions for a minimum of two hours, preferably over-night.

Complete details for use of the gray scales may be found on pp 81-2 of the *1957 AATCC Technical Manual and Year Book.*

Notes

(1) See Table I, page 56, *1957 AATCC Technical Manual and Year Book* for Procurement.

(2) See page 81, *1957 AATCC Technical Manual and Year Book* for description.

(3) A Neon Lamp Speed Tester Assembly is presently included with the Accelerotor accessories supplied by Atlas Electric Devices Co, 4114 North Ravenswood Avenue, Chicago 13, Illinois.

This item consists of a neon lamp, socket, and cord set for use on 115 volts 60* cycles for checking the speed of rotation of the impeller. It is used as a simple stroboscope to view the rotating impeller. With the test chamber door closed and the neon bulb held against the window of the door, the impeller gives distinct patterns at several useful speeds. With very little practice the following patterns will be recognized:

*1800 rpm—The impeller appears as a stationary distinct two-bladed figure.

*3600 rpm—The hub of the impeller appears as a stationary blur with two slight lobes apparent on the sides of the hub.

*If the power supply is 50 cycles, the test patterns are at 1500 and 3000 rpm respectively.

Turn the small screw on the tachometer face to correct reading.

(4) The use of an electric timer which will automatically start and stop the Accelerotor is recommended. Such a timer should be accurate to ±1 second after calibration.

(5) Vulcanol AL-100-5S available from Alco Oil & Chemical Corporation, Trenton Avenue & William Street, Philadelphia 34, Pennsylvania.

(6) The nonionic detergent should be of the polyethylene oxide condensate type (eg, Kyro E O manufactured by Proctor and Gamble Company).

Make up a 10% stock solution by dissolving 100 ml of such a nonionic detergent in distilled water to a total volume of one liter. Pipet five ml of the 10% stock solution into a one-liter volumetric flask and make up to the mark with distilled water. This results in a 0.05% test solution after thorough mixing.

(7) The 0.14% solution of acetic acid may be made by pipetting 0.5 ml of 28% acetic acid into a one-liter volumetric flask and making up to the mark with distilled water. This results in a 0.014% rinse solution after thorough mixing.

Committee on Water Resistance of Fabrics ———

RESISTANCE TO WETTING (ALTERNATIVE DYNAMIC IMMERSION ABSORPTION TEST)

Tentative Test Method 70A—1958

In 1952 the AATCC adopted the Dynamic Immersion Absorption Test as Tentative Test Method 70-1952. This test, as originally developed by the Army Quartermaster Corps, required the use of a six-liter jar with hexagonal sides incorporated into a motor-driven unit. This type of container soon became unavailable commercially and it was necessary to substitute one which could be readily procured. As a result of comparative tests by the Quartermaster Research and Development Laboratories using a six-quart cylindrical jar (commonly termed a "museum jar") and the standard hexagonal jar, it was found that the two jars were interchangeable. However, in 1954, the replacement jar became unavailable and a substitute could not be found.

The feasibility of utilizing the eight-inch metal tubes in the Launder-Ometer for a modified version of the dynamic absorption test thus became the subject of an investigation by the AATCC Research Laboratories. A selection of the optimum conditions, such as volume of water and number of steel balls, resulted from a series of comparative tests using the Launder-Ometer and the standard "tumble-jar" apparatus (cf ***American Dyestuff Reporter* 43,** P402-4, June 21, 1954).

The AATCC Committee on Water Resistance of Fabrics, under the chairmanship of C R Bellwood, then planned a series of interlaboratory tests comparing the Launder-Ometer method and the "tumble-jar" method and continued the work to a successful conclusion under the succeeding chairman, G A Slowinske.

As a result of a statistical study of the interlaboratory test results, it was found that the precision or reproducibility of the two methods is similar. On unlaundered fabrics, the absolute values obtained by the two methods are very close. On laundered fabrics, the Launder-Ometer method can be expected to average about 1.5 percent higher than the "tumble-jar" method. These differences are not great enough to affect the differences between fabrics. Either method rates fabrics in the same order.

Following the recommendation of the Committee, the AATCC, in March, 1958, adopted the proposed Launder-Ometer method as Tentative Test Method 70A-1958 (Resistance to Wetting—Alternative Dynamic Immersion Absorption Test).

The committee wishes to thank the following who participated in the interlaboratory tests:

A M Campbell, Quartermaster Research and Engineering Command
A A Cook, Arkansas Co
H B Goldstein, Warwick Chemical Co
G J Mandikos, AATCC Research Laboratories
G A Slowinske, Technical Laboratory, E I duPont de Nemours & Co, Inc.

The kind cooperation of H C Harris of the Chemical Control Departmnt of E I duPont de Nemours & Co, Inc for the statistical interpretation of the test data is gratefully acknowledged.

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W VON BERGEN

PURPOSE AND SCOPE———This method of test is applicable to any textile fabric, which may or may not have been given a water-repellent finish. It measures the resistance of fabrics to wetting by water. It is particularly suitable for measuring the water-repellent efficacy of finishes applied to fabrics, since it subjects the treated fabrics to dynamic conditions similar to those often encountered during actual use. It is not intended for use in predicting the probable rain penetration resistance of fabrics since it measures penetration of water into, but not through, the fabric.

This test method, which makes use of metal tubes in the Launder-Ometer, was developed as an alternate to Tentative Test Method 70-1952, which specifies the use of a six-liter jar that is not commercially available. Other advantages of the alternative method include saving in amounts of test fabric, blotters, and distilled water required. However, for referee cases Tentative Test Method 70-1952 should be used.

PRINCIPLE———Weighed specimens are tumbled in water for a fixed period of time and are reweighed after the excess water has been removed from them according to prescribed means. The percentage increase in weight is taken as a measure of the absorption or resistance to internal wetting.

APPARATUS AND MATERIALS ———Launder-Ometer operating at 42 rpm (*1, 2*)

Standard stainless-steel specimen containers, 3½″ in diameter by 8″ long (*2*)

Stainless steel balls, ¼″ in diameter (*2*)

Wringer, motor-driven (*3*)

Laboratory balance accurate to 0.1 g

"White AATCC blotting paper" cut to size of 4″ x 4″ (*4, 5*)

Distilled water at 80 ± 2° F. (27 ± 1°C)

TEST SPECIMENS———Two sets of ten square pieces, each 3″ x 3″, cut on a 45° bias from the conditioned (5) fabric, and with the loose corner yarns removed.

PROCEDURE———Place 300 ml of distilled water at 80 ± 2°F and 200 steel balls into one of the standard stainless steel containers. Roll together a set of ten pieces and weigh to the nearest 0.1 g. Repeat with the second set of ten pieces. Place each set, one piece at a time, into a separate stainless steel container. (Crumple each piece before placing it into the container.)

Run for 20 minutes at 80 ± 2°F (27 ± 1°C) in the Launder-Ometer at 42 rpm.

At the end of 20 minutes, quickly remove the pieces of one set, one at a time, pass each piece through the wringer once without blotters at the rate of 1" per second, with one edge of the piece parallel to the rolls of the wringer; then immediately pass it through the wringer between two unused blotters.

After running each piece through the wringer, first without and then with blotters, leave it between the blotters until the ten pieces from one set have been through the wringer; then remove the ten pieces from the blotters, roll them together, and weigh quickly to the nearest 0.1 g protecting the pieces from air drying as much as possible during these operations.

Repeat the squeezing, blotting, and weighing operations described above for the second set of ten pieces.

EVALUATION —— Divide the increase in weight for a set of ten pieces by the original conditioned weight of the set and multiply by 100 to obtain the percent of water absorbed. The dynamic absorption of the fabric is then obtained by averaging together the percent of water absorbed by each of the two sets of ten pieces, and should be reported to the nearest 1.0 percent.

NOTES——

(1) For a description of the Launder-Ometer and accessories, see page 84, *1957 AATCC Technical Manual and Year Book.*

(2) For procurement, see Table I, page 56, *1957 AATCC Technical Manual and Year Book.*

(3) The wringer, motor driven, should be equipped with soft rubber squeeze rolls approximately 12" in length and 2¼" in diameter, with a hardness of 70 to 80 (A scale) durometer units. The wringer should be so constructed that the pressure on the top of the piece of fabric is maintained by a dead weight or lever system such that the total pressure (resulting from the total of the dead weight or lever system and the weight of the roller) is 60 lbs. It should be power driven at a constant rate so that the piece of fabric passes through the rolls at the rate of one inch per second.

(4) White AATCC blotting paper may be procured from Standard Paper Manufacturing Company, Richmond, Virginia. For details, see Table I, page 56, *1957 AATCC Technical Manual and Year Book.*

(5) Both fabric and blotting paper must be conditioned at 65 ±2% rh. and 70 ±2°F (21 ±1°C) for at least four hours (preferably overnight). It is recommended that a supply of blotting paper be stored in the standard conditions laboratory.

Employment Register

This column is open for two insertions per year, per member, without charge. Blanks can be obtained from, and filed with, the secretary of the Association, Post Office Box 28, Lowell, Mass. It is understood that these will be open to inspection by prospective employers who can obtain further information from the secretary.

58-16

Education: BS, Philadelphia Textile Institute; MS, Clemson College.

Experience: plant chemist.

Location desired: East or South.

Position desired: chemist or research chemist.

Age: 27; single; references.

9-22, 10-6

58-17

Education: Textile eng (chemistry), Tilburg; business school and school of languages.

Experience: sales, lab assistant, dyer and finisher.

Location desired: South, Southeast, New York, New Jersey or California.

Position desired: sales, sales development of intermediaries, fibers, textile chemicals or dyestuffs.

Age: 39; married (three dependents); references. 9-22, 10-6

58-18

Education: MS, textile chemistry, Lowell Technological Institute (member of LTI Honor Society); Medical Field Service School, Texas.

Experience: Assistant chemist, Finishing Dept; chemist—fiber development.

Location desired: New England, Northeast or Midwest.

Position desired: Technical service with finish manufacturer or detergent manufacturer.

Age: 27; married, two dependents; references. 9-22, 10-6

AATCC CONVENTION ISSUE

THE October 20th issue of American Dyestuff Reporter will be devoted to the 37th National Convention of the AATCC, to be held October 30-November 1 at Chicago's Conrad Hilton Hotel, under the auspices of the Western Region.

Highlights of the issue will include the complete program for the technical sessions; abstracts of all technical papers, including the Intersectional Contest Papers; a feature story on this year's Olney Medalist, Henry E Millson; histories of the Sections comprising the Western Region; and descriptions of the exhibits of the various subcommittees of the Technical Committee on Research. Additional information of interest to the convention-goer, as well as a number of papers of current interest, will be included.

AATCC Calender

COUNCIL, COUNCIL COMMITTEES, RESEARCH COMMITTEES

Oct 30-Nov 1 (Conrad Hilton Hotel, Chicago, Ill); Jan 1959 (New York, NY); May 1959 (Montreal, Canada)

NATIONAL CONVENTIONS

Oct 30-Nov 1, 1958 (Hotel Conrad Hilton, Chicago); Oct 8-10, 1959 (Sheraton Park and Shoreham Hotels, Washington, DC); Oct 6-8, 1960 (Sheraton Hotel, Philadelphia, Pa); September 28-30, 1961 (Buffalo, NY); 1962 (Southern Region)

DELAWARE VALLEY SECTION

Oct 17, Dec 5

HUDSON-MOHAWK SECTION

Nov 14 (Chelsea House, Tribes Hill, NY); Jan 16 (Jack's Restaurant, Albany, NY); Mar 27 (Chelsea House, Tribes Hill, NY); May 15 (Ladies night, Albany area); June 26 (Annual outing—Antlers Country Club, Tribes Hill, NY)

METROPOLITAN SECTION

Oct 10 (Kohler's Swiss Chalet, Rochelle Park, NJ)

NIAGARA FRONTIER SECTION

Dec 5 (Buffalo, NY); Feb 20 (Niagara Falls, Ont); April 4 (Hamilton, Ont—joint meeting with CATCC)

NORTHERN NEW ENGLAND SECTION

Oct 17 (QM Research & Development Ctr, Natick, Mass); Dec 5 (Hotel Vendome, Boston, Mass); Jan 16 (Colonial Club, Lynnfield, Mass)

RHODE ISLAND SECTION

Oct 23 (Providence Engineering Society); Dec 4 (Annual Meeting—Johnson's Hummocks Grille, Providence)

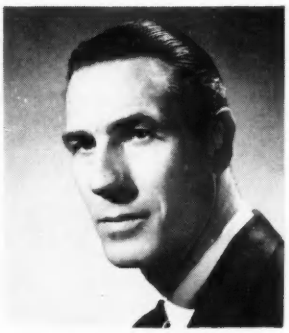
SOUTHEASTERN SECTION

Dec 6 (Atlanta, Ga)

WESTERN NEW ENGLAND SECTION

Oct 24 (Annual Meeting—Rapp's Restaurant, Shelton, Conn); Dec 5 (Rapp's Restaurant, Shelton, Conn)

ADDITIONAL NOMINATIONS FOR NATIONAL OFFICES



WELDON G HELMUS

SINCE the time of publication of the Nomination Notice in the August 25th issue of *American Dyestuff Reporter*, the executive secretary has received a nomination of Weldon G Helmus as candidate for president for the year 1959, supported by the required signatures of fifty or more Senior members.

Mr Helmus has formally withdrawn as a candidate for vice president for the Central Atlantic Region.

The executive secretary has received a nomination of Carlton T Anderson for vice president for the Central Atlantic Region, supported by the required signatures of twenty-five or more members of that Region.

These additional nominations will be given equal standing on the ballot, which is about to be mailed to voting members.

CARLTON T ANDERSON

ACTIVITIES OF THE LOCAL SECTIONS

South Central

THE regular fall meeting of the South Central Section was held September 13 at the Hotel Patten, Chattanooga, Tenn.

Speaker at the afternoon technical session, which attracted approximately sixty persons, was Ben H Kirby Jr, manager, Fine Chemicals Div, Koppers Co. He spoke on the subjects "Dyestuff Manufacturing" and "Fritz Ullman and This Colorful World."

William Martin Jr was in charge of the program for the evening banquet, which featured as speaker George Short, feature football writer for the *Chattanooga Times*, who spoke on "The Humorous Side of Football."

Announcement was made of the newly elected Section officers, as follows: *Chairman*—E V Helms, Geigy Dyestuffs; *Vice chairman*—E F Jurczak, Burkart-Schier Chemical Co; *Secretary*—Robert N Ingram, Lebanon Woolen Mills; *Treasurer*— R J Tyrrell, Peerless Woolen Mills; *Councilor*—Jack Anderson, Burlington Mills Corp. The Sectional Committee will consist of Lowell Shive, Arnold, Hoffman & Co, Inc; Arthur Williams, Du Pont Co; W J Welborn, Riegel Textile Corp; and Jack McNab, Mac Chemical Co.

Pacific Southwest

THIRTY members and guests attended the quarterly meeting of the Pacific Southwest Section at Swalleys Restaurant in Los Angeles, Calif, on September 19th.

Chairman Harold W Ellsworth conducted the regular business meeting and appointed the following committees: *Promotion of Local Textile Education*—Charles E Fuller, chairman; *Textile Scholarship*—Serge Dadone, chairman; *Nominating* — Angus H Roberts, chairman; *Annual Winter Dinner Dance*—Paul F Noonan, chairman.

Edwin B O Lindquist, chairman of the Annual Outing Committee, reported on the arrangements for the affair, which was scheduled for the Fox Hills Country Club, Culver City, Calif, on October 1st.

SOUTH CENTRAL SECTION OFFICERS (l to r): E V Helms, chairman; E F Jurczak, vice chairman; Robert N Ingram, secretary; R J Tyrrell, treasurer; and Jack Anderson, councilor.

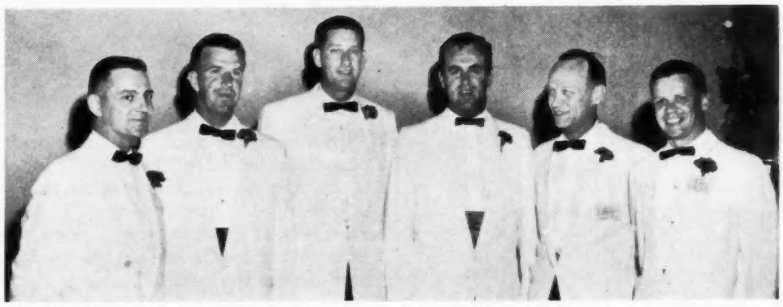
Piedmont

THE Piedmont Section held its 1958 Summer Outing at the Grove Park Inn, Asheville, NC, June 6-8 with some 467 members, wives, and guests attending. Among the guests were AATCC President George O Linberg, Mrs Linberg, Executive Secretary George P Paine, Mrs Paine, and Donald E Marnon, chairman of the Metropolitan Section.

A full program of activities including golf, putting, shuffleboard, swimming, dancing, bingo, and cards was featured.

Friday was devoted to golfing at the Asheville Country Club; sightseeing; and swimming, putting, and shuffleboard at the Grove Park Inn. Friday evening was highlighted by a cookout on the terrace of the Grove Park Inn, preceded by a well-attended social hour. This was followed by an informal dance with music by Fritz Albertson.

Saturday's activities were highlighted by the annual golf tournament, for which some 164 registered. Charlie Reese, Rock Hill Printing & Finishing Co, stole some of the glory from Bishop Smith, winner of the tournament with a 70, by scoring a hole-in-one. Other winners in golf were as follows: *Low Gross (Mill Division)*—Al Stafford, 76, Charlie Sutherland and Ben Caskey, 77, Bob Ward, 78; *Low Gross (Supply Division)*—Howard Carpenter, 73, Caroll Martin, 74, Dave Greene and Bruce Bishop, 76; *Callaway Event (Mill Division)*—Harold Keels, 71, Jim Marvin, Al Willard, and John Bell, 72; *Callaway Event (Supply Division)*—Ed Kent, 67, Jordan Dulin and Paul



Outing Committee (l to r): P D Cunningham, C E Gibson, D R Lassiter, E J Feeley II, R E Rettew, W Crowell. (Not included in photo, F P Mackinney)

HEAD TABLE (LEFT)—L to r: F P Mackinney; Mrs V B Wright; V B Wright; treasurer; Mrs R E Rettew; R E Rettew, outing chairman

HEAD TABLE (CENTER)—L to r: Mrs G O Linberg; G O Linberg, president; W E Rixon, chairman; Mrs Rixon; G P Paine, executive secretary

HEAD TABLE (RIGHT)—L to r: Mrs G P Paine; J C King, vice chairman; Mrs King; A R Thompson, custodian; Mrs Thompson, A H Gaede, national councilor

Presentation of E J Feeley Low Gross Cup: F P Mackinney (left) to Bishop Smith

Shuffleboard—L to r: D L Smart, M W Williams, Henry Wells, Lee Kritzer

Ladies Bingo Party

McGinty, 70, Oliver Goldstein, 71; *Ladies Low Gross*—Mrs Patsy Rendleman, 82, Mrs Caroll Martin, 96; *Ladies Callaway Event*—Mrs Ben Caskey and Mrs Clyde Whitesides, 73.

On Saturday morning, many of the ladies participated in Bingo. This was followed by a ladies luncheon and a well-attended bridge and canasta party in the afternoon. Shuffleboard and putting contests also were held on Saturday.

The Outing was brought to a close with a social hour, followed by a banquet in the Plantation Ball Room, and a semiformal dance. As the only business function, the recommendations of the Nominating Committee were presented at the banquet.

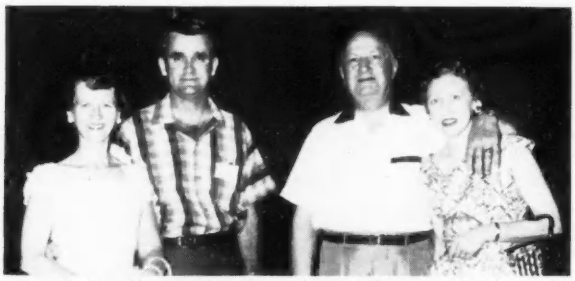
R E Rettew, Polymer Southern, Inc, served as chairman of the Outing. He was assisted by C E Gibson, Dow Corning Corp; F P Mackinney, Sandoz, Inc; E J Feeley II, E J Feeley Co, Inc; W Crowell, Moreland Chemical Co; D R Lassiter, National Starch Products, Inc; and P D Cunningham, Glyco Products Corp. E P Henley Crown Chemical, was social chairman.

Southeastern Section Outing

June 6-7, 1958 • Radium Springs Lodge, Radium Springs, Ga

(Photos by Claude B Suttle Jr, Southern States Chemical Co)

(All left to right)



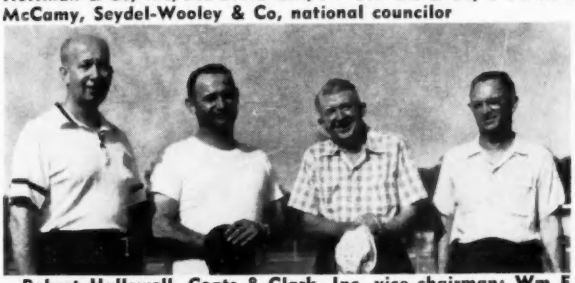
Mr & Mrs Howard Loveless, Crystal Springs Bleachery; Mr & Mrs Wm B Griffin, Dexter Chemical Co, Section chairman

Barney Hanson, F H Ross, Inc; Jim Hall, F H Ross, Inc, outing chairman; J Elwood Barbre, Pepperell Mfg Co

Max Ferguson, National Aniline; James Byars, Eagle & Phenix Div, Reeves Bros Inc; Wm T Brown, Fairfax Mill, West Point Mfg Co; Val Winkelman, Russell Mfg Co, sectional committeeman

Robert W Wurst, Penn Salt Mfg Co; Jas Root, Shell Chemical Corp; Chas S Huhn, Hercules Powder Co; Warren Tiller, Tennessee Corp, secretary

W O Bozeman Jr, Russell Mfg Co; Wm Kennady, Arnold, Hoffman & Co, Inc; Jos Stevenson, J P Stevens & Co; T Howard McCamy, Seydel-Wooley & Co, national councilor



Robert Hallowell, Coats & Clark, Inc, vice chairman; Wm E Fayssoux, Royce Chemical Co, national councilor; Roger H Dickinson, Coats & Clark, Inc; Jas Stevenson, J P Stevens & Co

Rhode Island

THE Rhode Island Section held its 25th annual outing and golf tournament on Friday, June 13, 1958 at the Wannamoisett Country Club, Rumford, RI.

Kenneth J Broden, The Sherwin-Williams Co, outing chairman, was aided by the following committeemen: Charles F Stokes, Carbic Color & Chemical Co, vice chairman; Walter E Murray, Crown Chemical Co, tickets-treasurer; Harrison M Gorton Jr, Koppers Co, Inc, printing and publicity; James C Shore, Metro-Atlantic, Inc, solicitations-door prizes; Kenneth C Everett, Kenyon Piece Dye Works, Inc, and John E Trezise, Karasell Chemical Corp, photography; Raymond K Andrew, U S Oil Co, lunch-dinner; Walker McBeath, American Cyanamid Co, golf-putting; Arthur Hustwit, Soluol Chemical Co, advisory.

Seated, l to r: Tom Toppin, Paul Esty, Harold Sturtevant (Section treasurer)
Standing, l to r: Cy Young, Joe Pailthorpe, William Rush

L to r: Arthur Hustwit, Ken Broden, Jim Shore (in rear), and Walter McBeath

Douglas Martland, winner of the sport shirt contest

Rhode Island
Section Outing
•
Wannamoisett
Country Club,
Rumford, RI
•
June 13, 1958

(Photos by Kenneth C Everett)

"Visiting firemen": Ernest R Kaswell (left), AATCC vice president, New England Region, and Azel W Mack, secretary, Northern New England Section

Distributing door prizes, l to r: Ken Broden, Jim Shore (with clock), Charles Stokes, Ken Bush

Seated, l to r: Arthur Donais, Kenneth Crowley, Everett Counsell, Armand Poitras
Standing, l to r: Richard Meyer, Matthew Quigley, Wilfred Senechal

Hudson-Mohawk

THE 10th annual outing of the Hudson-Mohawk Section, held June 20, 1958 under ideal weather conditions at the Antlers Country Club, Amsterdam, NY, attracted 126 members and guests, with 53 entering the golf tournament.

Results of the golf tournament were as follows:

Class A (members only)———Low gross and winner of the annual Ciba Trophy: William A Nelson, Ritter Chemical Co; 2nd low gross: Don Reisigle, Mohasco Industries; 3rd low gross: Dick Evans, Lee Dyeing Co.

Class B (guests only)——— Low gross: Keith Berner, Levitt-Berner Co; 2nd low gross: Martin Conway, Mohasco Industries; 3rd low gross: Carson Thompson, Mohasco Industries.

Class C (members and guests)———Nearest to the pin: Hank Mrozkowski, Mohasco Industries, and Frank Dietrick, Cluett-Peabody; longest drive: K P Fergason, Du Pont; most 4s: Irwin Smith Jr, Surpass Chemical Co, and Art Thomas, United Merchants; most 5s: Robert Cox, Solvay.

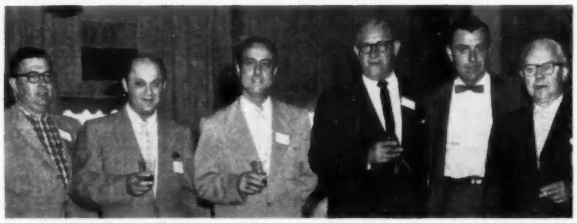
Edward A Chevrette, Apex Chemical Co, served as outing chairman. He was assisted by cochairman Achilles Mafilios, Ritter Chemical Co, and Louis Vavalla, Triangle Finishing Co.

Hudson-Mohawk Section Outing

June 20, 1958 • Antler's Country Club, Amsterdam, NY

HUDSON-MOHAWK SECTION OFFICERS (1957-8)—L to r: Floyd Szurek, Mohasco Industries, secretary; Achilles Mafilios, Ritter Chemical Co, outing cochairman and secretary-elect; Edward Chevrette, Apex Chemical Co, Section chairman and outing chairman; Walter Drautz, General Aniline, treasurer

William A Nelson (left), Ritter Chemical Co, winner of the golf tournament, receives Ciba Trophy from Maurice Fishman, Lee Dyeing Co, Section secretary and chairman-elect



L to r: John Condon, Emery Industries; Maurice Fishman, Lee Dyeing Co, secretary and chairman-elect; Armand DiMeo, Lee Dyeing Co, sectional committeeman; Herman Steen, Geigy; Al Rooney, Geigy, membership chairman; Ray Hardcastle, Fonda Glove Co

L to r: David Hamer, Arkansas Co; unidentified; Nat Shane, Arkansas Co; Fred Guay, H & F Binch Co; Don Nusum, Harris Dunlap, and Alvin Thomson, Palatine Dyeing Co; Jim Polito, Koppers Co

Dick Evans, Lee Dyeing Co, prepares to tee off

Pacific Northwest

THE Pacific Northwest Section held its annual outing August 9th at the Mt Hood Golf & Country Club, Welches, Oregon, located in the Mt Hood recreational area. The usual golf and horseshoe pitching tournaments were followed by a cocktail hour and dinner on the patio. Immediately after dinner, door prizes were drawn and attractive prizes awarded to winners of the various events.

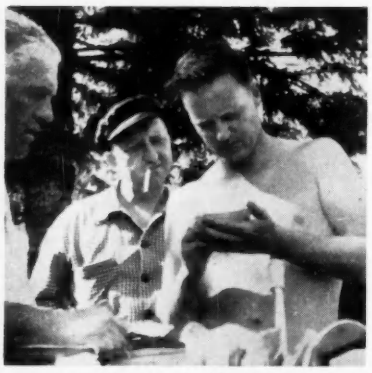
There were forty-three in attendance, including approximately seven guests. Guests were formally introduced during dinner.

Winners of the various golf tournament categories included: *Millmen*—Don Adams, 1st low gross; Tom Kay, 2nd low gross; E W Kay, 3rd low gross; Charles Bonthillier, 1st low net; John Reid, 2nd low net; Everett Newman, 3rd low net; Webb Morse, KP on No. 4; Dick Conley, long drive. *Suppliers*—Jack Gilberg, 1st low gross; Jack Shelton, 2nd low gross; George Zeagar, 3rd low gross; Dick Braun, 1st low net; George Maull, 2nd low net; Paul J Pernice, 3rd low net.

In the horseshoe pitching tournament, Russ Koenig took first prize, and Os Adrian, second prize.

Everyone in attendance received a door prize.

L to r: Dick Dahlstrom, L Potter, and C Bonthillier, Jantzen, Inc; Arnold Timmerman Sr, Portland Woolen Mills; Robert Newman, Jantzen, Inc



L to r: Jim Clark, National Aniline; Russ Koenig, Portland Woolen Mills, PNW Section chairman; Don Adams, Portland Woolen Mills

L to r: Bud Shea, Jantzen Inc; Jack Gilberg, General Chemical Div, PNW Section vice chairman; John Ayers, Du Pont, PNW Section Councilor

L to r: R Newman, Jantzen Inc; Paul J Pernice, General Aniline & Film, PNW Section secretary; Jim Clark, National Aniline, C Bouthillier, Jantzen Inc

Washington

AT ITS first meeting of the new season, the Washington Section will meet at the Textile Museum, Washington, DC, this Friday evening, October 10th.

At the affair, which has been designated ladies' night, Louisa Bellinger, the museum's curator analyst, will discuss "Modern Studies of Ancient Textiles." Miss Bellinger will describe the background and details of some of the ancient rugs and fabrics collected by the museum from many parts of the world. A guided tour of the museum's exhibits will be followed by a question period.

A brief business meeting covering nomination of officers for 1959 will precede the technical program.

Metropolitan

THE Metropolitan Section will hold its fist meeting of the fall season on October 10th at Kohler's Swiss Chalet, Rochelle Park, NJ.

Two technical papers will be presented: "A Quantitative Measurement of Fabric Appearance—A Practical Evaluation of Wash and Wear Characteristics", by C R Williams, Monsanto Chemical Co; and "Some New Developments in the Application of Cibacron (Reactive) Dyes", by Fernand Schlaeppi, technical manager, Ciba Co, Inc.

A Nominating Committee consisting of John Hennessey, *chairman*, Paul J Luck and Patrick J Kennedy has been named by Chairman Donald E Marnon.

Northern New England

JOHN T Taylor, manager of New product development, Rohm & Haas Co, will discuss "Nonwoven Fabrics: The Technology of Bonding Agents" at the October 17th meeting of the Northern New England Section. The meeting will be held at the Quartermaster Research and Development Command Center, Natick, Mass.

Mr Taylor will describe the numerous types of chemicals and auxiliaries required in the production of nonwoven fabrics. The properties and chemistry of thermoplastic and thermosetting binders will be discussed.

Head table guests will include members of the Quartermaster staff.

NOTICE TO AUTHORS OF PAPERS

MANUSCRIPTS for the *Proceedings* and for other publications of the American Association of Textile Chemists and Colorists shall conform to the requirements and standards given in this *Notice*. Before publication, manuscripts for the *Proceedings* shall be approved by the Editor, not only for editorial correctness according to the standards of this *Notice*, but also for content of technical matter. In his work, the Editor may enlist the aid of anonymous reviewers who are selected for expert knowledge in particular fields.

It is presumed that authors in studying the comments of reviewers and of the Editor will remember that all recommendations are made in a kindly, helpful, sympathetic manner to improve the paper in both literary and technical excellence. Although authors should cheerfully consider suggestions, they are expected to defend their position if justified, especially when strictly technical matters are involved with which the authors have an intimate knowledge.

AATCC strives to maintain a high scientific and professional standard for papers. Authors must make every effort to avoid the use of trade names, commercial products or process names wherever such use may be construed as advertising. Wherever possible, scientific nomenclature must be employed. For example, Part I designations in the new *Colour Index* should be used in place of dyestuff trade names. It is recognized that in some instances trade names are necessary to avoid lengthy description. Certain trade names have been so widely used as to become generic and these normally are permissible. Further, some technical papers may involve the presentation of a new product or process wherein trade name reference is obligatory.

Giving due consideration to such valid exceptions, it is incumbent upon the author to maintain the proper scientific attitude, avoiding any expressions or devices aimed at promoting a particular product or process.

Questionable papers are to be referred to the chairman of the Publications Committee, who will submit them to an editorial board which would be appointed as needed. The Board would report to the Publications Committee, which would have the final voice in accepting or rejecting a paper.

MANUSCRIPTS — Manuscripts shall be typewritten double-spaced with approximately one-inch margins on 8.5x11-inch white paper. In addition to the *original*, at least one carbon copy is required. Pages are to be numbered consecutively with Arabic numerals, and each page after the first shall carry the authorship at the very top. Tables and figures shall also be numbered consecutively, the tables with headings containing Roman numerals as TABLE I, TABLE II, etc, and the figures with Arabic numerals as Figure 1, Figure 2, etc, appearing *below* the figures. The names of the authors and their laboratories or business connections should appear below the title of the paper.

LITERARY STYLE AND FORM OF PRESENTATION—In the writing of papers, authors are requested to observe a trenchant, simple style of writing directed to textile chemists and colorists with at least an elementary knowledge of chemistry, physics, mathematics, engineering, textile processes and textile machinery.

In the organization of the material, there should be one or more introductory paragraphs setting forth the occasion, significance and main objectives of the paper and of the method of attack. This should be followed by the body of the presentation, either with discussions interspersed throughout this portion or with a collected section marked "DISCUSSION" after the main body of the paper. Finally, there may be a brief section at the end entitled "SUMMARY" or "CONCLUSIONS."

Center and side headings make for easier reading. Center headings should be employed sparingly and generally will include only very important section headings, such as "INTRODUCTION," "EXPERIMENTAL," "DISCUSSION," "CONCLUSIONS," "SUMMARY," and "REFERENCES." Side headings (see sixth paragraph of this *Notice* for an example) shall be indented and run into the text to which they apply, and shall be separated from the paragraph by a dash. The publisher will print center headings in bold-face capitals and side headings in capitals.

LITERATURE REFERENCES AND FOOTNOTES—References to the literature and all footnotes (except those in tables) shall be numbered consecutively with underlined Arabic numerals in parentheses at the proper place in the text. Where a reference or footnote is to be used again, the original number is simply repeated; this obviates the necessity of repeating the footnote or reference at the bottom of the page. Reference to the literature shall conform to the universal usages followed by *Chemical Abstracts*, which include underlining of journal names to indicate italicization in printing. The abbreviated codes for many journal names appear on page 143 of the 1956 *Year Book*.

The spelling and rules of punctuation followed in manuscripts shall be those found in the "Merriam-Webster New International Dictionary"; abbreviations and chemical formulas shall conform to *Chemical Abstracts*.

FIGURE AND GRAPHS—Figures and graphs should be black line drawings on white drawing paper. Photographic prints are acceptable, preferably glossy prints on double-weight paper. Duplicates should be available for dispatch to reviewers. In graphs, the frame and actual curves should be inked more heavily than the co-ordinate lines, and these latter should not be too close together. Various styles of broken lines are sometimes desirable to distinguish curves. Experimental points should be given with small plane figures, such as circles, squares, diamonds or triangles. Numbers and legends on co-ordinate axes are to be lettered in the graph by the author. Numbers and titles of figures should be placed below the diagram or on the edge of the back. Each piece of illustration copy should bear on the margin or on the edge of the back the name of the author and the title of the paper.

SYNOPSIS—A separately written synopsis of not over 200 words containing the gist of the subject matter must accompany every manuscript.

REPRINTS — Fifty overrun copies of papers published in the *Proceedings* will be furnished without charge by the publisher if requested when galley proofs are returned. These are printed on one side of the sheet only and then stapled together. A schedule of prices of reprints in the usual form accompanies the galley proofs, which will be sent to the author before publication.

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TRADEMARKS—As the AATCC wishes to co-operate in the protection of trademarks, it is requested that, in the body of the article, trademarks be written with an initial capital letter.

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(deceased)

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Central Atlantic Region

DELAWARE VALLEY.....*Chairman*: WILLIAM S SOLLENBERGER, American Viscose Corp, Marcus Hook, Pa; *Secretary*: ERNST W EMPTING, Verona Dyestuffs, 357 Lancaster Ave, Haverford, Pa; *Vice Chairman*: L KEVIN McCHESNEY; *Treasurer*: CLARENCE A SEIBERT

HUDSON-MOHAWK ..... *Chairman*: MAURICE FISHMAN, Lee Dyeing Co, Johnstown, NY; *Secretary*: ACHILLES MAFILIOS, Ritter Chemical Co, Amsterdam, NY; *Vice Chairman*: FLOYD J SZUREK; *Treasurer*: WALTER DRAUTZ

METROPOLITAN.....*Chairman*: DONALD E MARNON, Berkshire Color & Chemical Co, 250 Delawanna Ave, Delawanna, NJ; *Secretary*: RICHARD P MONSAERT JR, Puritan Piece Dye Works, 550 E 38th St, Paterson, NJ; *Vice Chairman*: JOHN A KOMNINOS; *Treasurer*: RICHARD E MILLER

NIAGARA FRONTIER.....*Chairman*: WILLIAM H LEYKING, National Aniline Div, Allied Chemical & Dye Corp, 1015 S Park Ave, Buffalo, NY; *Secretary*: NORBERT WEINBERG, Becco Chemical Div, Food Machinery & Chemical Corp, Sta B, Buffalo 7, NY; *Vice Chairman*: KENNETH A LISTER; *Treasurer*: ANTON M VIDITZ-WARD

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STUDENT CHAPTERS

Alabama Polytechnic Institute, Bradford Durfee College of Technology, Clemson College, Georgia Institute of Technology, Lowell Technological Institute, New Bedford Institute of Technology, North Carolina State College, Philadelphia Textile Institute, Rhode Island School of Design

Abstracts

(*concluded from page 678*)

3) Ferrous mordant process (for pigmented wools).

The alkaline process was in use before 1890. Its greatest use is for hosiery yarn and fabric. The method is simple to operate, the wool being merely steeped for 2-12 hours or overnight at a temperature not exceeding 120°F in a peroxide solution containing stabilizers such as phosphates and sodium silicate.

The acid bleaching process, on the other hand, is based on a system of padding on to the wool an acid solution of peroxide, followed by immediate drying or aging.

Chemical modification of the wool, as indicated by alkali solubility, is much lower by the acid process than with alkaline steeping. The degree of whiteness obtained by the mild acid bleach, however, is not equal to that obtained by the alkaline method.

The ferrous mordant process, for pigmented wools, consists of an initial mordanting treatment for two hours, in the presence of formaldehyde which acts as a protective influence on the wool. An alkaline peroxide bleaching treatment follows. The iron is said to act catalytically at the pigmentation sites.

For bleaching cotton with peroxide the authors give a typical formula calling for additions of sodium silicate, soda ash and caustic soda. This formula gives a pH of 10.3-10.8. The bleaching process is described in great detail.

The authors state that the method of continuous bleaching, developed in the U S, has now spread to Great Britain and Continental Europe. There is a saving in labor, time, chemicals and steam, and a uniform and reproducible white is obtained.

Peracetic acid was developed commercially for the removal of heat-setting discoloration from nylon, for which it is a most useful bleaching agent. The bleaching solution, with addition of Calgon and a wetting agent, is adjusted to pH 7 with caustic soda and heated to 180°F. Peracetic acid may also be used on viscose rayon, secondary acetate and triacetate.

The authors also refer briefly to a recent use of peracetic acid as a shrink-resist finish on wool.

The Flash-aging of Vat-printed Viscose Rayon Fabrics

Fern, A S and Liquorice, W F, *J Soc Dyers Col* 74, 331-43, May, 1958.

The evolution of pad-steam processes for fixing printed vat dyes on cellulosic fabrics is traced by the authors, who refer to the Colloresin method, the Du Pont pad-steam method, and the Savagraph vat emulsion process.

In this paper, the term *flash-aging* refers to a process comprising the following stages:

1) The vat dye is dispersed in a thickening agent capable of coagulation by alkali, printed and dried. There is no need to proceed immediately to the next stage.

2) The fabric is padded in a slightly thickened solution of sodium hydrosulfite and caustic soda.

3) Immediately after 2), the fabric is steamed in saturated air-free steam at about 100-102°C for 15-30 seconds.

4) Immediately after 3), the fabric is oxidized and soaped in the normal manner for vat dyeings.

The authors state that the reducing system used in flash-aging is potentially capable of converting *all* vat dyes completely to the leuco form. However, many vat dyes are unsuitable for flash-aging because of a tendency to flush during steaming. A table of 71 dyes (all British) is presented, in which they are classified according to their tendency to flush.

The selection of a suitable thickener is important. The thickener must aggregate on entering the pad-liquor if a sharp definition is to be maintained and marking-off on the pad mangle is to be avoided. The thickening recommended by the authors is a combination of wheat starch, gum gatto and sodium alginate.

The padding trough should be of small volume and should be fed continuously with fresh reduction liquor.

The ager should a) provide an ample supply of saturated or slightly superheated steam to both sides of the fabric, b) allow for a steaming time of up to 20 seconds, 3) prevent any contact of the printed side of the cloth with any part of the equipment. An illustration and diagram of a suitable ager are included.

The percentage fixation of a selected range of dyes on viscose rayon and on cotton under flash-aging conditions compares favorably with that obtained by the "all-in" normal sulfoxylate-carbonate printing process, where the steaming time may be sixty times as long. Many vat dyes show improved brightness and or color value when steamed for short times, owing to the absence of leuco decomposition or over-reduction. Such a flash-aging process is ideally suited to screen printers and to those machine printers who wish to augment their steaming capacity with little capital expenditure.

Additional advantages claimed for flash-aging are the complete stability of the print between printing and steaming, the applicability of some vat dyes that cannot be printed by the conventional method, and a saving of steam.

Nineteen references to the literature are cited.

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Organo-tin Compounds as Textile Preservatives

Hueck, H J and Luijten, J G A, *J Soc Dyers Col* 74, 476-80, June, 1958.

It has been reported that certain organo-tin compounds have high biocidal activity against both fungi and insects. The authors have studied the performance of these compounds as possible textile preservatives, eg, for the protection of wool from attack by insects and for the protection of cellulosic fibers against damage by microorganisms.

Tetraethyl tin, tetraphenyl tin, and several other related compounds were applied to wool serge in benzene or trichloroethylene solution. The treated and untreated wool was exposed to attack by the clothes moth and the carpet beetle under standard conditions for 14 days, and the weight loss was determined. The test was repeated on similar treated wool that had been washed up to three times. A comparison was also made with other insecticides, DDT and Mitin FF. The results are given in tabular form.

Tributyl tin was found to be about as active against the insects mentioned as DDT and much more active than Mitin. However, the latter product is far superior to DDT and the best organo-tin compound as regards fastness to washing, which is a requisite for permanent mothproofing.

Triethyl tin hydroxide and several other related products, similarly dissolved in organic solvents, were applied to jute and cotton. The fabrics were then tested by several methods for rotproofness, including a soil burial test. A comparison was also made with copper naphthenate and DDM. The tests were repeated on treated samples after leaching with running water for 36 hours. The results are given in tabular form.

Two of the organo-tin compounds seem to be promising. Diethyllauryl tin acetate in particular has considerable resistance to leaching, and possibly has affinity for cellulose. The authors suggest that it be studied further.

News of the Trade

VDI Sets 5-Year Goal

Greatly expanded sales of vat dyestuffs for the textile industry, reaching a total of fifty million pounds by 1963, is the projected five-year goal of the Vat Dye Institute. H J Daigneault, president, cited this target figure from a recent report of the Institute undertaken to analyze ways and means of combating any trend to downgrading of colorfastness quality and threatened increased use of more white fabrics in the cotton textile industries.

To achieve this goal, the Vat Dye Institute, Inc, a nonprofit organization of leading vat color producers in the United States, is placing primary emphasis on promoting the use of more color on cotton and rayon fabrics where color is not used to any great extent at present, and where color will give added sales value to the material.

Other major areas of development, the report stated, include upgrading color quality in mass marketed cotton and rayon for apparel and decorative fabrics, and to build the use of vat colors in the wash-and-wear field, where colorfastness is vitally important in maintaining consumer confidence.

Calling attention to published statistics on the projected growth in consumption of rayon fabrics in the next decade, as well as the wash-and-wear merchandising potential for cotton goods, the report to members stressed the importance of a coordinated Institute drive to encourage high color-quality standards through use of fast vat dyes.

The tendency to downgrading, resulting in sacrifice in product quality, should be especially guarded against during periods when profit margins are slim, Mr Daigneault said.

"For instance," he explained, "a concern may be using a top-quality vat color. A substitute offering will result in a lower cost, and while it may "get by" will not be quite as colorfast as the original color. Further substitutions are offered for this color, each time downgrading the colorfastness a little more. "By the time the fifth or sixth substitution has been made, each with its saving, the color eventually reaches a point where it is far from satisfactory. The final result, multiplied by substitutions on numerous other shades, is loss of confidence in colored goods on the part of the ultimate purchaser. In the past, this has caused a large increase in the popularity of white fabrics, which hurts not just the vat dye field but the entire textile dyestuff industry."

Outlining the Vat Dye Institute's role in the wash-and-wear field, the executive noted that exaggerated claims of some merchandising people have caused misunderstandings and much harm. "Ignorance of the facts is probably more responsible for this than deliberate intentions to misrepresent these easy-care items. "Our job," he said, "is to work as closely as possible with leading retailers, mills, cutters, trade associations and publications to tell the whole story." This, he pointed out, includes correcting the impression that wash-and-wear fabrics do not require conventional washing because they do not soil easily and shed dirt more readily. It also means making clear to the trade that ordinary dyes under a resin finish do not acquire vat color fastness to washing.

"Long range prosperity is directly related to consumer satisfaction," Mr Daigneault stated. "It is certain that the ultimate consumer, the housewife, who is the real buyer of textile fabrics, will pay more if she is educated about the real value of vat colors. It follows that the garment cutter, the converter, the textile manufacturer and the finisher, all of whom are familiar with the good fastness properties of vat dyes, will produce the quality demanded for retail stores."

Additional information on the Institute and its activities is available from Henry Herrmann, Executive Secretary, Empire State Building. 350 Fifth Avenue, New York 1, New York.

Pyrazol Fast Scarlet RL

Claimed to possess the best fastness to light of any direct scarlet on the market, Pyrazol Fast Scarlet RL is a new dyestuff offered by Sandoz, Inc, 61 Van Dam St, New York 13, N Y. It is stated that is assures a minimum of shade change in resin finishing, and its reserve of acetate is termed excellent.

HIW CHANGES NAME

Howes Publishing Co, Inc, publishers of *American Dyestuff Reporter*, has announced a name change in another of its publications.

The former *Hosiery Industry Weekly* has been changed to *Knitting Industry Weekly* to better identify the publication with the wider market area it now covers—underwear, sweaters and other knitted products, as well as hosiery.

GAF Marketing Changes

Major changes in the marketing organization of the Dyestuff & Chemical Division of General Aniline & Film Corporation were announced recently by Harold G Shelton, director of marketing of the Division.

A key feature of the new organization is the expansion of the product-line manager concept, from two to eight product managers, each responsible for a given line of products. The product managers are responsible for much of the creative work involved in sales development of their respective product lines and are supported by the services of the entire Division. The eight groups, four each in General Dyestuff Co and Antara Chemicals, are the core of the Dyestuff & Chemical Division Home Office marketing operation supporting the line sales organization.

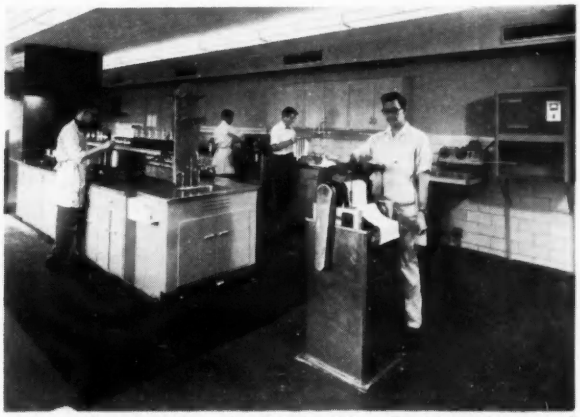
Supporting the product managers are four staff groups, one headed by a technical manager, who coordinates research and product development with sales, one by an advertising manager who develops advertising and sales promotion programs, a third headed by a manager of sales development, who assists the product managers in the introduction of new products, development of new markets for existing products, and acts as general sales consultant to the product managers and field salesmen, and the fourth one headed by a manager of sales administration who supervises the training of sales personnel and coordinates administrative services.

"The new organization was established," Mr Shelton said, "to gear the Division's sales efforts to greater product diversification and the expansion of markets for its line of chemicals, dyes, and pigments."

Personnel named to staff the new organization are: J R Bonnar, sales manager of General Dyestuff Co; J M Cloney, sales manager of Antara Chemicals; C M Knowles, technical manager; R J Hamilton, advertising manager; C E Stevens, manager, sales development; J T Robinson, manager, sales administration.

According to P M Dinkins, vice president and general manager of the Dyestuff and Chemical Division, the organizational changes which were begun last fall are "already showing marked results in expanding sales and improving the profitability of the dye, chemical and pigment lines."

Mayor Kenneth Cass of Greenville (left) is shown cutting ribbon during ceremony officially opening new regional textile dyestuff service center of The Hilton-Davis Chemical Co. Looking on, l to r, are Harold L Hansen, vice president of Sterling Drug; S Y Stribling; and Nelson S Knaggs.



View of technical service lab in Hilton-Davis' newly opened regional textile distribution center in Greenville. Lab equipment shown includes laboratory-size padding and printing machines, a Macbeth Lablite; a Launder-Ometer; and a laboratory-size package-dyeing machine

Hilton-Davis Opens New Textile Dye Center

The official opening of Hilton-Davis Chemical Co's modern research and sales distribution center for textile dyestuffs in Greenville, SC, took place September 6th with appropriate ceremonies.

Marking the opening of the South's newest textile dye distribution facilities, Mayor Kenneth Cass of Greenville officiated at a ribbon-cutting ceremony. Attending the "open house" reception and dinner was a large group of textile executives, chemists and colorists, local civic and business leaders, as well as officials of Hilton-Davis' plant in Cincinnati and its New England and Atlantic coast regional distribution centers.

Hilton-Davis first established a dyestuff center in Greenville in 1954. Using rented space, it opened operations in the heart of the South's textile-producing and processing area in order to provide "on-the-spot technical service, know-how and rapid dyestuffs delivery to our customers," explains Nelson S Knaggs, Hilton-Davis' vice-president in charge of sales.

"It shortly became apparent that we would have to expand our facilities to keep pace with the growth of the textile trade here and our own increased business," he notes.

The new Hilton-Davis building is regarded as an outstanding example of modern industrial design, and has been nominated by the Greenville Chamber of Commerce as a contender in the annual "Top Plants Competition" sponsored by *Factory Management and Maintenance*.

The 20,000 square feet of building space are allocated to laboratory, warehouse and shipping, and administrative functions. The technical service laboratory, outfitted with the latest equipment, is designed to work in close cooperation with textile mills with respect to solving individual color problems. Air-conditioning is installed in the laboratory and office areas.

Feature of the large warehouse is a huge "cold storage" vault to keep dyes "fresh" despite outside weather conditions. An average of 750,000 pounds of dyestuffs is stored in the warehouse, set up for quick identification and selection of dyes, which are then moved to adjoining loading docks for shipment in Hilton-Davis trucks.

The building also contains a large mixing room where the company's Spectrosols, a line of stabilized diazo printing compounds, are custom-made to mill requirements.

Manager of the Hilton-Davis center in Greenville is S Y Stribling III. The laboratory is under the direction of Wilbur K Hammett, assisted by Willard Waldrup Jr, Zeddie Collins, Troy Grant and Robert E Langston. The sales staff, headed by Mr Stribling, includes J Dorman Compton and William S Pearson.

Other Hilton-Davis personnel who attended September 6 event were: William S Johnson, vice-president in charge of production; John H Walker, assistant secretary; George F Martin, assistant to Mr Knaggs; George N Nichols, textile technical service manager; William Green, New England regional manager; Donald S Hirtle, chief chemist; T A Langstroth, associate director, pigment research; Willard Sharp, manager of textile sales, Middle Atlantic Division; and Jack Reininger, Hilton-Davis Engineering Division.

New Data-Processing Equipment at DRM

Almost $1,000,000 worth of electronic data processing equipment whirred into life recently at Dan River Mills, Inc, one of the nation's biggest and most diversified textile manufacturers.

Reputedly the largest installation to date in the textile industry, the new electronic marvel will give to Dan River's management in a matter of minutes information which formerly could be obtained only over a period of hours, days, or even weeks, it is claimed.

The data-processing center includes 17 separate machines, weighing 14 tons, all interconnected to operate as a single system. The "electronic brain" has over 7,000 vacuum tubes, almost 7,000 diode tubes, operates at 17 different voltage levels, and has more than 3,600 magnetic cores in which to store information. It generates enough BTU's per hour to heat three five-room houses, gobbles up enough electricity to light 72 houses. A 45-ton air conditioning unit maintains proper temperature to prevent breakdown of the electronic circuits from excessive heat.

According to J W Vanderwerff, company controller who spearheaded the computer project, programs have already been developed for using the new system to provide statistical data in the vital areas of production, inventory, supply control, payrolls, and other related accounting functions. Also, the New York sales headquarters will receive current information on the progress of fabric orders in production, finished goods available for sale, and projections as to styles and patterns available at later specified dates. Additional programs are under study, and will be incorporated into the system as rapidly as possible.

The electronic data processing equipment is scheduled to operate 90 hours per week, with rental for the intricate machinery to be based on actual hours of operation.